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Electrical Experimenter

233 FULTON STREET, NEW YORK

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer; R. W. DeMott, Sec'y;) 233 Fulton Street, New York.

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Ether and Space

FOR thousands of years it was an establisht fact that the earth stood still, with the sun, moon and stars revolving around it. All known evidence, visual and otherwise, supported the "fact." But humanity with its deceptive senses had been fooled for generations, until the "establisht fact" was disproved by one Galileo, who brought very convincing proofs that it was the sun that stood still.

Since Euclid, down to a very few years ago, scientists thought that light was always propagated along absolutely straight lines. Einstein, however, showed an astonished world that a ray of light may be curved considerably. Indeed, we appear to have proofs to support him.

Again, for over one hundred years we have accepted unhesitatingly Faraday's teachings that the whole universe is permeated with a very tenuous and exceedingly fine substance, the ether. Faraday and Maxwell, in order to explain the wave theory of light and other electromagnetic waves, invented the ether, as they reasoned that you cannot have waves without a suitable medium in which to vibrate these waves. The ether, accordingly, is a substance so fine, so minute, that it permeates and fills not only the entire universe but all other substances. It fills the space between atoms in metals and all other solids or fluids; in short, it is everywhere. It was reasoned that the ether must have elastic, jelly-like material properties in order to explain many mystifying phenomena, but nothing of the actual structure of the ether is known.

But now Einstein and his followers come along and flatly deny all existence of the ether. In their support it must be said that there are no experimental proofs of the existence of the ether. The ether, in short, is only a theory, which was never proved—but so far also never entirely disproved. If a light ray is material, the ether is no longer required to explain its propagation. Indeed, all recent researches along this line tend to show that light *is* material. We know for instance that the sunlight exerts a pressure of many thousand tons upon the surface of the earth upon which it falls. This is termed the pressure of light. But can you exert pressure upon a body unless the light which exerts it has "body"; in other words, is material? Then, too, if a light ray is deflected in a gravitational field, it certainly must be material.

Once arrived on these premises let us see how space looks to our mental eye, robbed of its hypothetical ether. We will now have a vast vacuum, nothing but a vacuum at a temperature of—273° Fahrenheit. But how can a light ray, or a radio ray (wave) cross this bottomless void? An analogy may perhaps help here. Imagine a man stationed out in space shooting a stream of a non-freezing liquid earthward from a fire-hose. Suppose he vibrates (shakes) the nozzle back and forwards slightly. This would impart to the liquid stream a wave motion the same as we know a light ray has. There being no friction, the wave motion of the liquid stream would persist till the stream reaches the earth's atmosphere, where it would break up into drops.

Now we have seen that given a material stream we need no medium such as the ether to hurl it earthward. If, then, light and other electromagnetic waves are material, we no longer require the ether to explain the wave motion. We can even explain how it comes that the intensity of light diminishes inversely as the square of its distance. If a light ray is material—let us say composed of electrons—we can conceive how, thru its terrific speed of 186,000 miles per second, a certain quantity of electrons are lost continuously in space during its course. These electrons would probably be flipped off from the crests of the wave.

The next decade will no doubt shed further "light" on the question.

H. GERNSBACK.

The **ELECTRICAL EXPERIMENTER** is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $2.00 a year in U. S. and possessions. Canada and foreign countries, $2.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 20 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. **A green wrapper indicates expiration. No copies sent after expiration.**

All communications and contributions to this journal should be addrest to: Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British agents—Geoffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London.

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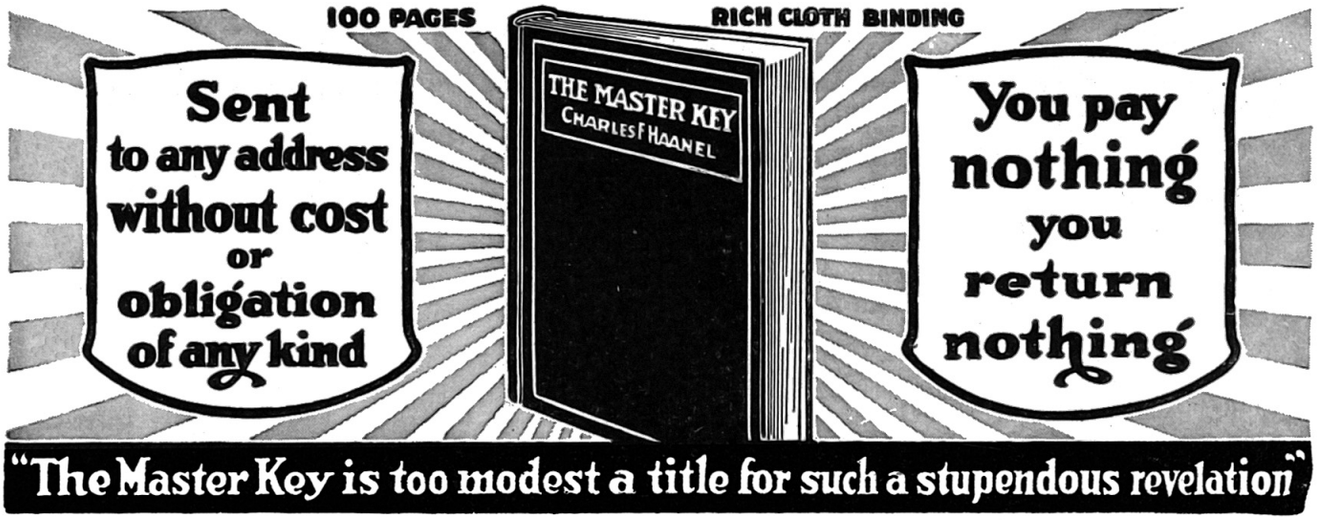

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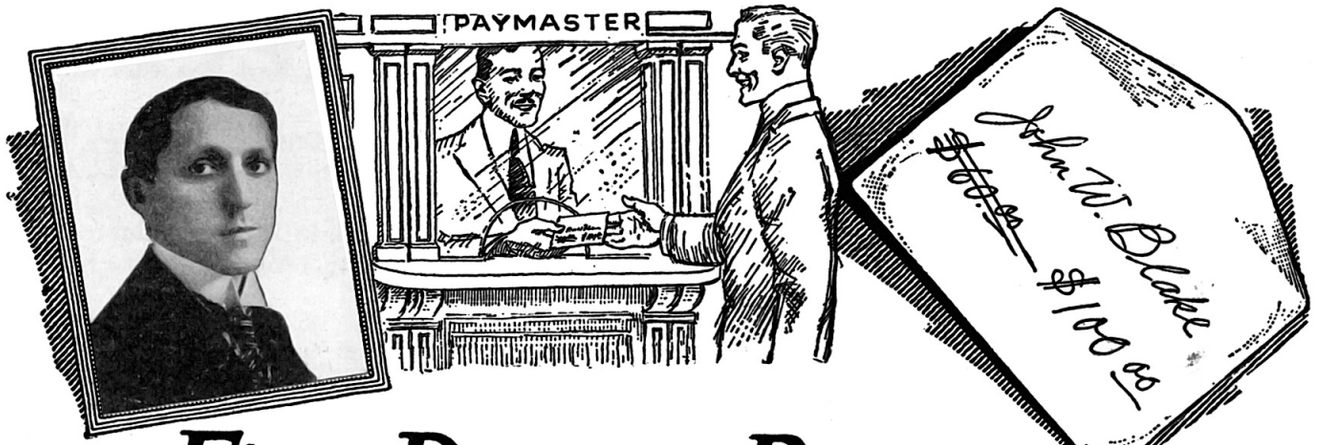

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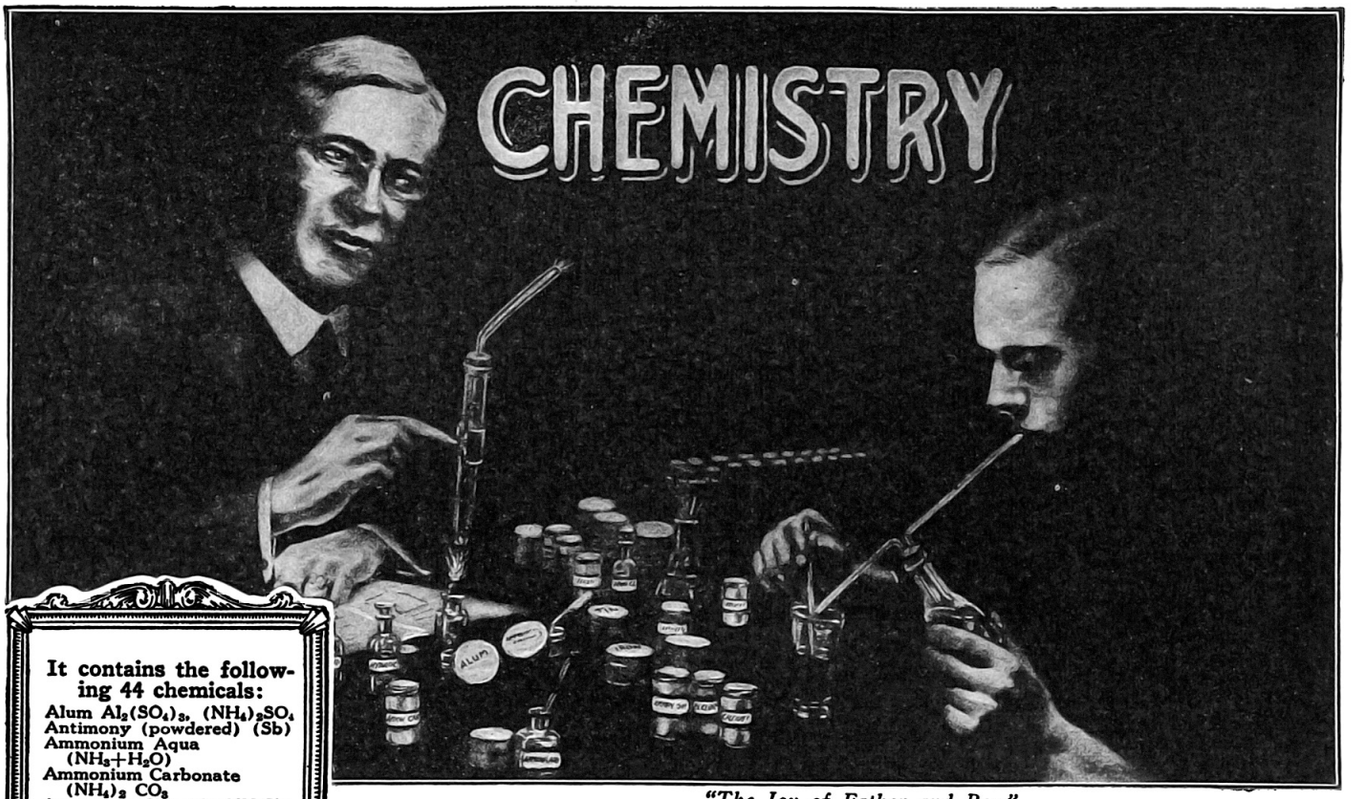

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Among the **100 Experiments** are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make chemical colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

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Antimony (powdered) (Sb)
Ammonium Aqua (NH_3+H_2O)
Ammonium Carbonate $(NH_4)_2CO_3$
Ammonium Chloride (NH_4Cl)
Ammonium Sulphate $(NH_4)_2SO_4$
Barium Chloride ($BaCl_2$)
Boric Acid (H_3BO_3)
Brimstone (Sulphur) (S)
Calcium Chloride ($CaCl_2$)
Calcium Oxide (CaO)
Calcium Sulphate ($CaSO_4 2H_2O$)
Charcoal (Carbon) (C)
Chloride of Zinc ($ZnCl_2$)
Copper Sulphate ($CuSO_4$)
Ferrous Sulphate ($FeSO_4$)
Ferrous Sulphide (FeS)
Glycerol (Glycerine) $C_3H_5(OH)_3$
Hydrochloric Acid (HCl)
Iodine (I)
Iron Chloride ($FeCl_3$)
Iron Oxide (Fe_2O_3)
Lead Acetate Pb $(C_2H_3O_2)_2$
Litmus Paper
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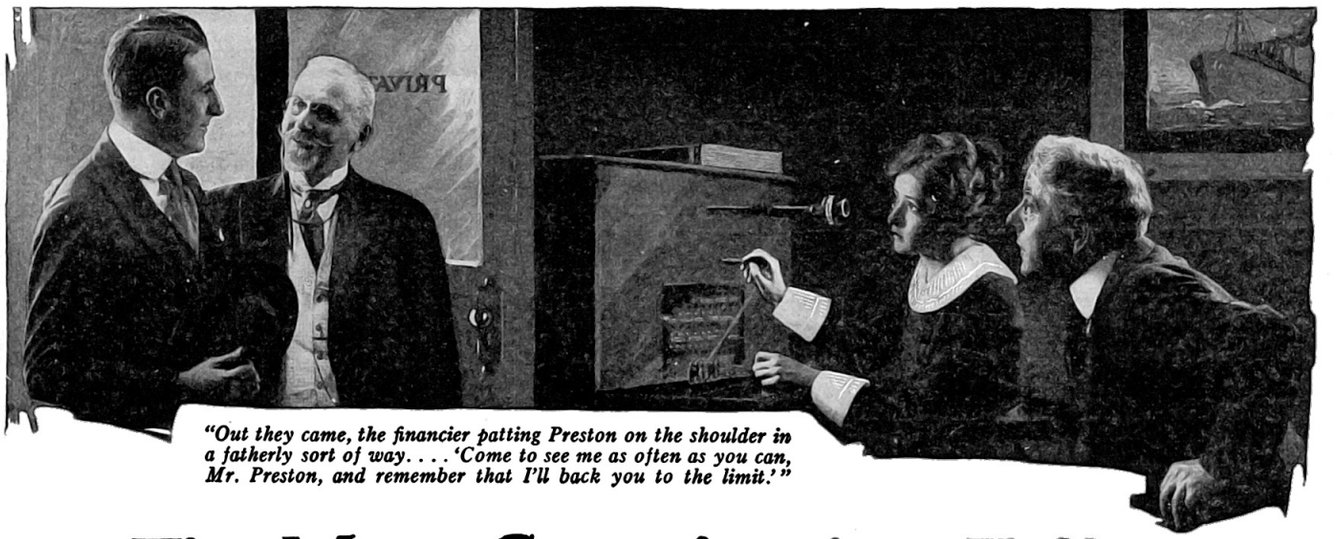

"Out they came, the financier patting Preston on the shoulder in a fatherly sort of way. . . . 'Come to see me as often as you can, Mr. Preston, and remember that I'll back you to the limit.'"

The Most Convincing Talker I Ever Met

Everywhere this man goes, people shower him with favors and seek his friendship. Things which other people ask for and are refused, he gets instantly. How he does it is told in this amazing story.

LET me ask you this: There is a big business deal to be put through. It involves millions of dollars. Putting it through depends wholly on one thing—getting the backing of a great financier.

But this man is bitterly opposed to your idea and to your associates. Seven of the most able men and women in all America have tried to win over this financier. They failed dismally and completely.

Now, could you, a total stranger to this man, walk in on him unannounced, talk for less than an hour, and then have him take your arm as a token of friendship, and give you a signed letter agreeing to back you to the limit?

Could you?

ASTOUNDING? Yes! But it *W A S* done. And I'll tell you how. Here is the way it all came about. For a long time the directors of our company had felt the handicap of limited capital. We had business in sight running into a million dollars a month. But we couldn't finance this volume of sales. We simply had to get big backing, and that was all there was to it.

Because of trade affiliations, one man—a great financier in New York—controlled the situation. Win him over and the rest was easy. But how to win him?—that was the question. No less than five men and two women—all people of influence and reputation—had tried. They were all repulsed—turned down cold and flat.

You know how a thing of this sort grows on you and how bitter utter defeat is. Well, we were talking it over at a board meeting, when one of our directors announced that he knew of only one man who could possibly put through the deal—a man by the name of Preston.

So it was agreed that Preston was to be sounded out at luncheon the following day. He proved to be a fine type of American. At 34 years of age he had become president and majority stockholder of a thriving manufacturing business rated at three-quarters of a million dollars.

Preston was deeply interested, as anyone would be over the prospect of closing such a big deal. The director in question said casually, "Why don't you run down to New York and take a shot at it, Preston?" Preston looked out of the window for a moment, and then quietly answered, "You're on."

I WENT along with Preston simply as a matter of form to represent our interests. Aboard the 10:25 train out of Chicago we headed for the smoker and got to talking with the crowd there.

Then I noticed something. Preston had dominated them all. Everyone was eagerly hanging on his words, and looking at him with open admiration. No sooner would he stop talking than one of the men would start him up again. And as the men dropped off at stations along the way they gave Preston their cards, with pressing invitations to look them up. No doubt about it, Preston was *T H E* man aboard that car.

The colored porter, too, came under his sway. For that night, when the berths were being made up, the porter came unasked to Preston, told him that his berth was right over the car trucks, and insisted upon changing it to a more comfortable one.

And so it went all the way to New York. Everyone who met Preston took a great liking to him the instant he spoke. They seemed to be eager for his companionship — wanted to be with him every minute, openly admired him, and loaded him with favors.

Even the usual haughty room clerk at the hotel showed a great interest in Preston's welfare. He showered us with attention while a long line of people waited to register.

The next morning we called on the great financier—the man who was so bitterly against us and had flatly turned down seven of our shrewd influential representatives.

I waited in the reception room—nervous, restless, with pins and needles running up and down my spine. Surely Preston would meet the same humiliating fate?

But no! In less than an hour out they came, arm in arm, the financier patting Preston on the shoulder in a fatherly sort of way. And then I heard the surprising words, "Come to see me as often as you can, Mr. Preston, *and remember that I'll back you to the limit!*"

AT the hotel that night sleep wouldn't come. I couldn't get the amazing Preston out of my thoughts. What an irresistible power over men's minds he had. Didn't even have to ask for what he wanted! People actually competed for his attention, anticipated his wishes and eagerly met them. What a man! What power! . . . Then the tremendous possibilities of it all—think what could be done with such power.

What was the secret? For secret there must be. So the first thing next morning I hurried to Preston's room, told him my thoughts, and asked him the secret of his power.

Preston laughed good-naturedly. "Nothing to it —I—well—that—is—" he stalled. "I don't like to talk about myself, but I've simply mastered the knack of talking convincingly, that's all."

"But how did you get the knack?" I persisted.

Preston smiled, and said, "Well, there's an organization in New York that tells you exactly how to do it. *It's amazing!* There's really nothing to study. It's mostly a knack which they tell you. You can learn this knack in a few hours. And in less than a week it will produce definite results in your daily work.

"Write to this organization—the Independent Corporation—and get their method. They send it on free trial. I'll wager that in a few weeks from now you'll have a power over men which you never thought possible . . . . but write and see for yourself." And that was all I could get out of the amazing Preston.

WHEN I returned home I sent for the method Preston told me about. It opened my eyes and astounded me. Just how he had won over the financier was now as clear as day to me. I began to apply the method to my daily work, and soon I was able to wield the same remarkable power over men and women that Preston had. I don't like to talk about my personal achievements any more than Preston does, but I'll say this:

When you have acquired the knack of talking convincingly, it's easy to get people to do anything you want them to do. That's how Preston impressed those people on the train—how he won over the financier—simply by talking convincingly.

This knack of talking convincingly will do wonders for any man or woman. Most people are afraid to express their thoughts; they know the humiliation of talking to people and of being ignored with a casual nod or a "yes" or "no." But when you can talk convincingly, it's different. *When you talk people listen and listen eagerly.* You can get people to do almost anything you want them to do. And the beauty of it all is that they think they are doing it of their own free will.

In committee meetings, or in a crowd of any sort you can rivet the attention of all when you talk. You can force them to accept your ideas. It helps wonderfully in writing business letters—enables you to write sales letters that amaze everyone by the big orders they pull in.

Then again it helps in social life. Interesting and convincing talk is the basis of social success. At social affairs you'll always find that the convincing talker is the centre of attraction, and that people go out of their way to "make up" to him.

Talk convincingly and no man—no matter who he is—will ever treat you with cold, unresponsive indifference. Instead, you'll instantly get under his skin, make his heart glow and set fire to his enthusiasms. Talk convincingly and any man—even a stranger—will treat you like an old pal and will literally take the shirt off his back to please you.

You can get anything you want if you know how to talk convincingly. You've noticed that in business, ability alone won't get you much. Many a man of real ability, who cannot express himself well, is often outdistanced by a man of mediocre ability who knows how to talk convincingly. There's no getting away from it, to get ahead—merely to hold your own—to get what your ability entitles you to, *you've got to know how to talk convincingly!*

THE method Preston told me about is Dr. Law's "Mastery of Speech," published by the Independent Corporation. Such confidence have the publishers in the ability of Dr. Law's method to make you a convincing talker that they will gladly send it to you wholly on approval.

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ABOUT six months ago I got the scare of my life. Edith was worried, too. But in the end it was one of the best things that ever happened to us.

I guess I had a pretty close call. The doctor said afterwards that he never expected me to pull through.

But it wasn't my own sickness that gave me my fright—at least, I wasn't alarmed about myself. It was the sick condition of the family finances, and thinking of Edith and the boy that put me in a panic.

There I was, flat on my back in bed; a big doctor's bill running up; a trained nurse to pay every week; and no reserve to fall back on—not a dollar laid by for emergency.

Luckily the firm was good enough to continue my salary without a break, or I don't know what we would have done.

The things that went through my mind during that slow process of getting well made me feel like a criminal. Suppose the worst had happened? No provision for Edith and the boy except a little insurance—the total amount not enough to last more than a year at the rate we had been living.

It hurt like a stab. It seems incredible that two people in their right minds could drift along the way we had been doing, constantly living up to the last cent, constantly on the edge of a slippery precipice. Yet according to statistics, something like 50% of all the men in America over sixty years of age are dependent on relatives or charity for support—including men who had earned princely incomes when in their prime. Think of it! And all because they had failed to look ahead—had never learned how to save. It hit me right between the eyes. For I was nearly thirty-two years old—certainly old enough to know better; yet I wasn't a dollar nearer independence than when I was twenty.

One day, while still in bed, I ran across something in one of the magazines that opened my eyes to our whole trouble.

It said that most people make hard work of saving simply because they don't go at it in the right way. Their money doesn't last long because they have no check on it—no definite system for adjusting their outgo to their income. It said the only practical way is the budget system—split your salary up into proportionate parts; allow so much each week for this, so much for that, and then stick to it.

Then the article told of an almost automatic way for doing this—a new system for managing personal affairs; it was called the Ferrin Money Making Account System.

It struck me that this was just what Edith and I needed if we ever expected to get our feet on solid ground. When I showed my discovery to Edith, she agreed with me, and immediately sent for the complete system.

That little step has proved to be our salvation. It has helped us put nearly $500 in the bank in less than six months—out of the same salary that was formerly never enough. At the same time it helped us to pay a big doctor's bill without ever missing the money.

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But when you have seen what big returns the Ferrin System will pay you, you will surely want to keep this wonderful aid to money-making, especially as we are now making a special short-time offer of only $3 for the complete System.

You will appreciate what a remarkable offer this is when you consider that other expense account books are sold for $3 and cover a period of only two years. The Ferrin Money Making Book covers four years, and therefore has twice the value, $6. And in addition you get the Ferrin Kitchen Calendar, the Ferrin Pocket Account Book, the Ferrin Investment and Insurance Register, the Ferrin Household Inventory and Fire Insurance Record, each worth 50 cents, or $2. You have the opportunity, therefore, of securing $8 value for only $3.

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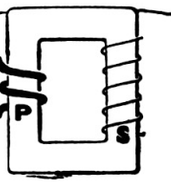

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A Startling Memory Feat That You Can Do

How I learned the secret in one evening. It has helped me every day

WHEN my old friend Faulkner invited me to a dinner party at his house, I little thought it would be the direct means of getting me a one-hundred-and-fifty per cent. increase in salary. Yet it was, and and here is the way it all came about.

Toward the close of the evening things began to drag a bit, as they often do at parties. Finally some one suggested the old idea of having everyone do a "stunt." Some sang, others forced weird sounds out of the piano, recited, told stories, and so on.

Then it came to Macdonald's turn. He was a quiet sort of chap, with an air about him that reminded one of the old saying that "still waters run deep." He said he had a simple "stunt" which he hoped we would like. He selected me to assist him. First he asked to be blindfolded securely to prove there was no trickery in it. Those present were to call out twenty-five numbers of three figures each, such as 161, 249, and so on. He asked me to write down the numbers as they were called.

This was done. Macdonald then astounded everyone by repeating the entire list of twenty-five numbers backwards and forwards. Then he asked people to request numbers by positions, such as the eighth number called, the fourth number, and so on. Instantly he repeated back the exact number in the position called. He did this with the entire list—over and over again, without making a single mistake.

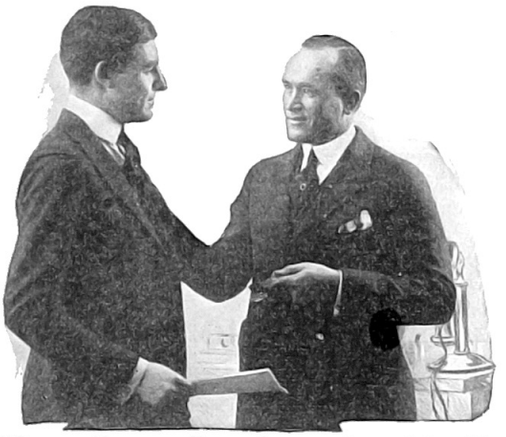
Then Macdonald asked that a deck of cards be shuffled and called out to him in their order. This was done. Still blindfolded, he instantly named the cards in their order backwards and forwards. And then to further amaze us, he gave us the number of any card counting from the top, or the card for any number.

You may well imagine our amazement at Macdonald's remarkable feat. You naturally expect to see a thing of this sort on the stage, even then you look upon it as a trick. But to see it done by an everyday business man, in plain view of everyone, blindfolded and under conditions which make trickery impossible, is astonishing, to say the least.

* * * * * *

ON the way home that night I asked Macdonald how it was done. He said there was really nothing to it—simply a memory feat, the key to which anyone could easily learn in one evening. Then he told me that the reason most people have bad memories is because they leave memory development to chance. Anyone could do what he had done, and develop a good memory, he said, by following a few simple rules. And then he told me exactly how to do it. At the time I little thought that evening would prove to be one of the most eventful in my life, but such it proved to be.

What Macdonald told me I took to heart. In one evening I made remarkable strides toward improving my memory and it was but a question of days before I learned to do exactly what he had done. At first I amused myself with my new-found ability by amazing people at parties. My "memory feat," as my friends called it, surely made a hit. Every one was talking about it, and I was showered with invitations for all sorts of affairs. If anyone were to ask me how quickly to develop social popularity, I would tell him to learn my memory "feat"—but that is apart from what I want to tell you.



"Our president complimented me on always being able to tell him instantly facts he wanted to know."

The most gratifying thing about the improvement of my memory was the remarkable way it helped me in business. Much to my surprise I discovered that my memory training had literally put a razor edge on my brain. My brain had become clearer, quicker, keener. I felt that I was fast acquiring that mental grasp and alertness I had so often admired in men who were spoken of as "wonders" and "geniuses."

The next thing I noticed was a marked improvement in my conversational powers. Formerly my talk was halting and disconnected. I never could think of things to say until the conversation was over. And then, when it was too late, I would always think of apt and striking things I "might have said." But now I can think like a flash. When I am talking I never have to hesitate for the right word, the right expression or the right thing to say. It seems that all I have to do is to start to talk, instantly I find myself saying the very thing I want to say to make the greatest impression on people.

It wasn't long before my new-found ability to remember things and to say the right thing at the right time attracted the attention of our president. He got in the habit of calling me in whenever he wanted facts about the business. As he expressed himself to me, "You can always tell me instantly what I want to know, while the other fellows annoy me by dodging out of the office and saying 'I'll look it up.'"

* * * * * *

I FOUND that my ability to remember helped me wonderfully in dealing with other people, particularly in committee meetings. When a discussion opens up the man who can back up his statements quickly with a string of definite facts and figures usually dominates the others. Time and time again I have won people to my way of thinking simply because I could instantly recall facts and figures. While I'm proud of my triumphs in this respect, I often feel sorry for the ill-at-ease look of the other men who cannot hold up their end in the argument because they cannot recall facts instantly. It seems as though I never forget anything. Every fact I now put in my mind is as clear and as easy to recall instantly as though it were written before me in plain black and white.

We all hear a lot about the importance of sound judgment. People who ought to know say that a man cannot begin to exercise sound judgment until he is forty to fifty years of age. But I have disproved all that. I have found that sound judgment is nothing more than the ability to weigh and judge facts in their relation to each other. Memory is the basis of sound judgment. I am only thirty-two, but many times I have been complimented on having the judgment of a man of forty-five. I take no personal credit for this—it is all due to the way I trained my memory.

THESE are only a few of the hundreds of ways I have profited by my trained memory. No longer do I suffer the humiliation of meeting men I know and not being able to recall their names. The moment I see a man his name flashes to my mind, together with a string of facts about him. I always liked to read but usually forgot most of it. Now I find it easy to recall what I have read. Another surprising thing is that I can now master a subject in considerably less time than before. Price lists, market quotations, data of all kinds, I can recall in detail almost at will. I rarely make a mistake.

My vocabulary, too, has increased wonderfully. Whenever I see a striking word or expression, I memorize it and use it in my dictation or conversation. This has put a remarkable sparkle and pulling power into my conversation and business letters. And the remarkable part of it all is that I can now do my day's work quicker and with much less effort, simply because my mind works like a flash and I do not have to keep stopping to look things up.

All this is extremely satisfying to me, of course. But the best part of it all is that since my memory power first attracted the attention of our president, my salary has steadily been increased. Today it is many times greater than it was the day Macdonald got me interested in improving my memory.

* * * * * * *

WHAT Macdonald told me that eventful evening was this: "Get the Roth Memory Course." I did. That is how I learned to do all the remarkable things I have told you about. The publishers of the Roth Memory Course—the Independent Corporation—are so confident that it will also show you how to develop a remarkable memory that they will gladly send the Course to you on approval.

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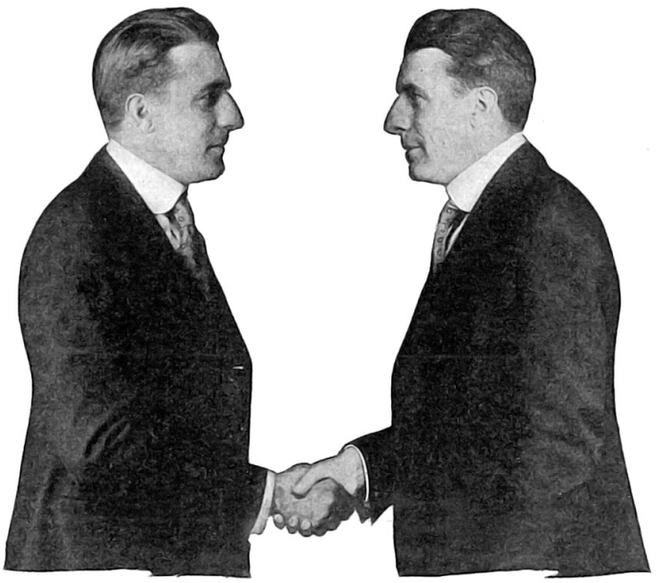
A CLERK since 1911! Eight long years I had been at the same desk, the same work, and almost the same pay. And, from all signs ahead, 1930 would still find me in the same old grind.

Perhaps you may know just how I felt. At 9:00 every morning I would hang up my hat, settle in my chair and get set to "put in another day." Never a single rush of joy for my work. For some men I knew, each week meant a succession of big deals crowned with big rewards. For me, Monday dragged into Tuesday, which crawled wearily into Wednesday, which finally overlapped into Thursday, and so on—until the welcome oasis of Saturday afternoon and Sunday at home. And then came another week, etc., etc., ad infinitum.



One day, in February of this year, came an incident which was later to mean a great deal to me. While getting together some data for our salesmanager (who had only been there a short time) I overheard part of his conversation with one of his salesmen.

"Willis," I heard him say to the salesman, "I'm *mighty* sorry that you have fallen down on your job. But I really knew when I came here that you would never make a good salesman. I knew it by your face, your carriage, and your manner of speech. Salesmanship isn't written on any part of you. I have given you your chance and you admit that you are misfit in your present position. But I feel sure that you could make an A-1 success in other work. Because a man fails in one line is no reason that he will not make good in another. I believe that you have the capabilities of an excellent office manager and if you wish I will see——"

The door slammed shut but my mind seemed to have been torn loose from its rut. Was *I* a misfit? Was *I* really in the position I was naturally fitted for? I had just drifted into this "clerk's job" eight years ago without studying myself for my biggest capacities. I merely wanted a job—and I got it. I *knew* I had the capacity for big things *in the right line*. But what *was* my right line?

For more than a week I tried to think it out and decide what was best to do. Finally I determined to ask the advice of the salesmanager himself. He had helped Willis and perhaps he would help me. It would do no harm to talk with him and he might be able to help me make a decision.

So I put the whole matter up to him, and asked him to give me the benefit of his opinion.

I felt his keen gaze bore through me as I spoke. Instinctively I knew that his ears were listening to my story but that his eyes were making a sharp estimate of their own.

Finally he spoke. And to my amazement, he solved the whole problem for me. "Henning," he said, "you have been swimming against the current, I do not believe that your *real* work is at a clerk's desk. It might seem that I am hasty but my judgment is usually right. You could, I firmly believe, make a real success as a salesman. I'm willing to give you the chance. If you *don't* succeed, then it will be one of the very few mistakes I have ever made in sizing a man up by his face."

Well, I *did* succeed. I knew it—because money talks and my salary tells me so. I am known as one of the best salesmen in the firm. And now, instead of looking on my work as drudgery, I enjoy it as a great game. Thru my salesmanager's courtesy, I have learned to read character at a glance from the little course he studied and which the publishers sent me for free examination. I find it of immense help to me. Most of us know a few things about character readings. We know that a high forehead indicates the intellectual type—that a receding chin denotes weakness while a pronounced chin means determination. But often these signs are counterbalanced by others which are just as apparent but which the average person doesn't recognize. Consequently we often jump to conclusions about people which later prove incorrect. It's like trying to read a sentence by looking at the first one or two words.

It's all as clear as a book when you know the simple alphabet of signs that spell out a man's character and mental "slants"—an alphabet that is surprisingly easy to learn and of remarkable value to apply. People with whom I had never been able to get along I now number among my best friends. I am popular with my co-workers and receive their hearty co-operation and good-will. In my business dealings, when I approach a prospect I know immediately whether to use tact or sweep him away by enthusiasm—whether to get right down to business or open up in a roundabout way—what angle of talk will make the best appeal to each man and what arguments will clinch him.

I know immediately just how to deal with everyone I meet. I know how to interest them, how to appeal to them most effectively, how to touch their "responsive chord." I can gauge at once their tastes, mental traits, temperament, and personality. Immediately upon meeting a man I know how to make him my friend. At least 40 per cent. of the credit for my success I attribute to my easily-acquired ability to read at sight the character of everyone I meet.

Just as Nature intended that the normal condition of our bodies is perfect health, so the normal condition of everyone is perfect success. We are all meant to be a success at *something*. We all have the capacity within us to achieve big things *in the right line*. If we are not a big success, it is merely because we are in the wrong occupation. Napoleon was a failure at authorship. Florence Nightingale failed as a social favorite. Grant was a failure at everything until he became a soldier. These were their *wrong* occupations. We all have the germ of success within us—the capacity to do big work in some one line. The thing to do is find out what *your* line of work is.

Dr. K. M. H. Blackford has helped thousands of men find out the work for which they were best fitted to achieve big success. This famous character analyst has been retained at record fees by such corporations as the Westinghouse Electric and Manufacturing Company, Scott Paper Company, The Laurentide Co., Ltd., and many other big concerns, to pick and place rightly the men they employ. And 98 per cent. of Dr. Blackford's selections—regardless of their previous experience—made good at the jobs in which they were placed.

Dr. Blackford has helped thousands of others and is now ready to help you. A good many of us are just plugging day in and day out at work we are not naturally fitted to do, work we do not like, work we can never fully succeed at. We swim against the tide, trying to fit our given set of talents to the wrong job. But thru Dr. Blackford, we can now all judge in just what line our biggest success lies. And we can learn the worthwhile secret of knowing, in one quick survey of their features, physique, gestures, and habit of conversation, unerringly the character of every person we meet—of looking *into* people and *through* them, instead of *at* them.

Thru the little course of lessons in "Reading Character at Sight" now being distributed by Dr. Blackford, we can know, the minute we lay eyes on people, how to make them our friends, in either a business or social way—how to talk to them, how to influence them to the best advantage. Thru the secrets given by Dr. Blackford, we can get a better line on the folks we meet than the friends who have known them for years.

Thousands have already benefited thru the course. Some have decided thru it just what their life-work really is. Others have saved themselves from business disaster and unscrupulous partners. Many others have avoided hiring men whom they knew at a glance to be dishonest and unreliable. Many salesmen use the knowledge they have gained to judge and approach their prospects. Executives use it to deal with and judge their employes. Doctors use it in dealing with their patients. Lawyers find it of great help in their court work and in their actions towards clients. Public speakers employ it in judging their audience, and in debate.

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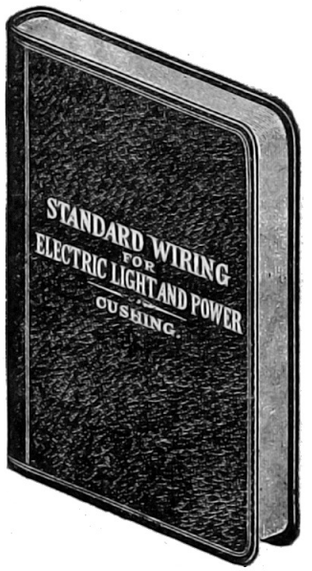

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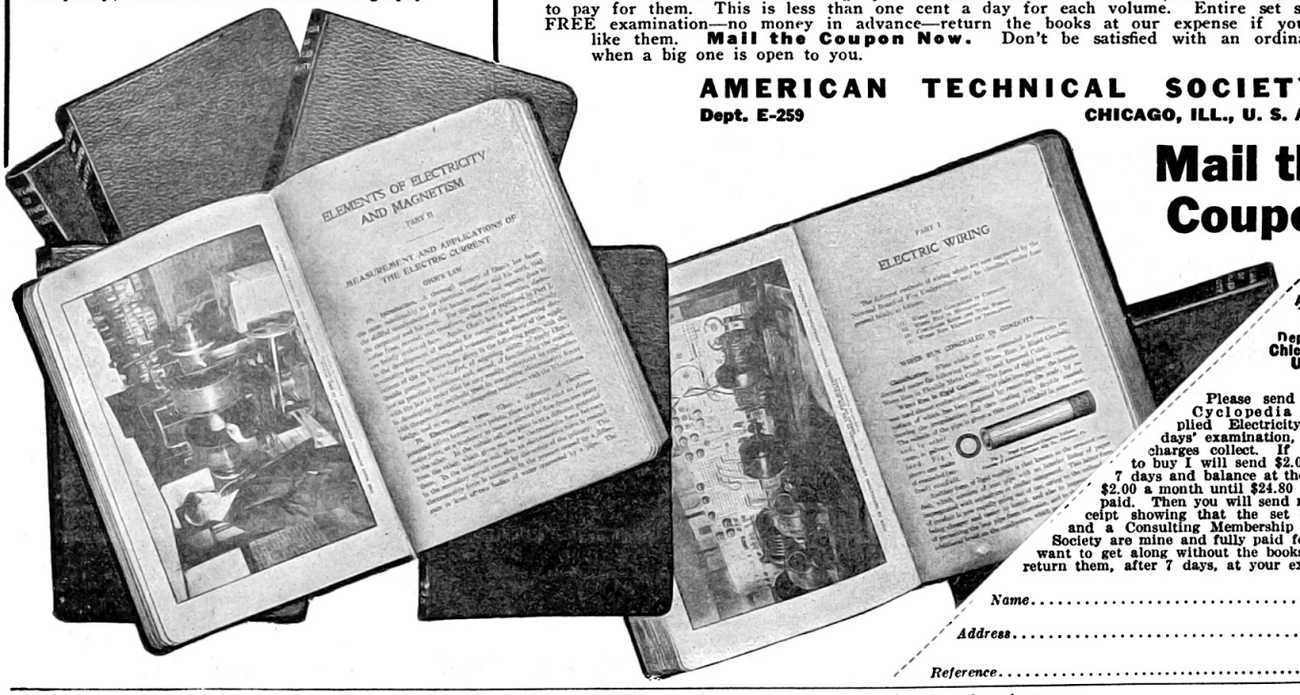

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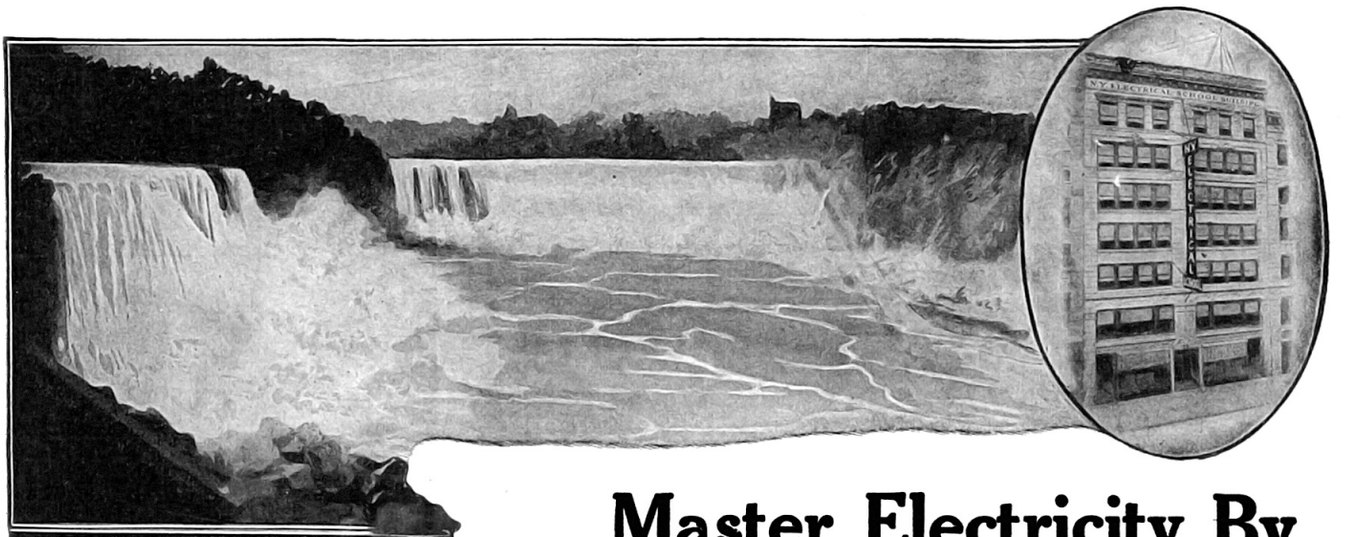

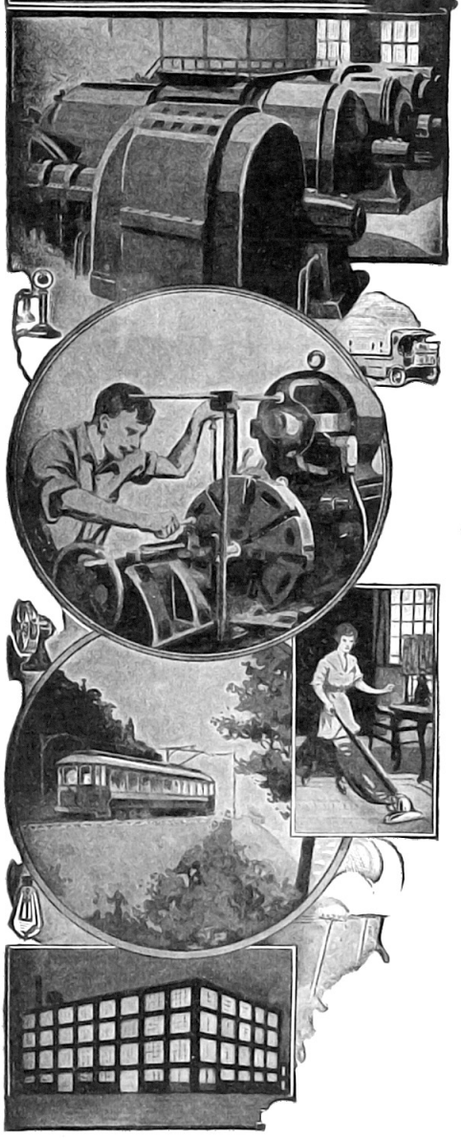

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ELECTRICAL EXPERIMENTER

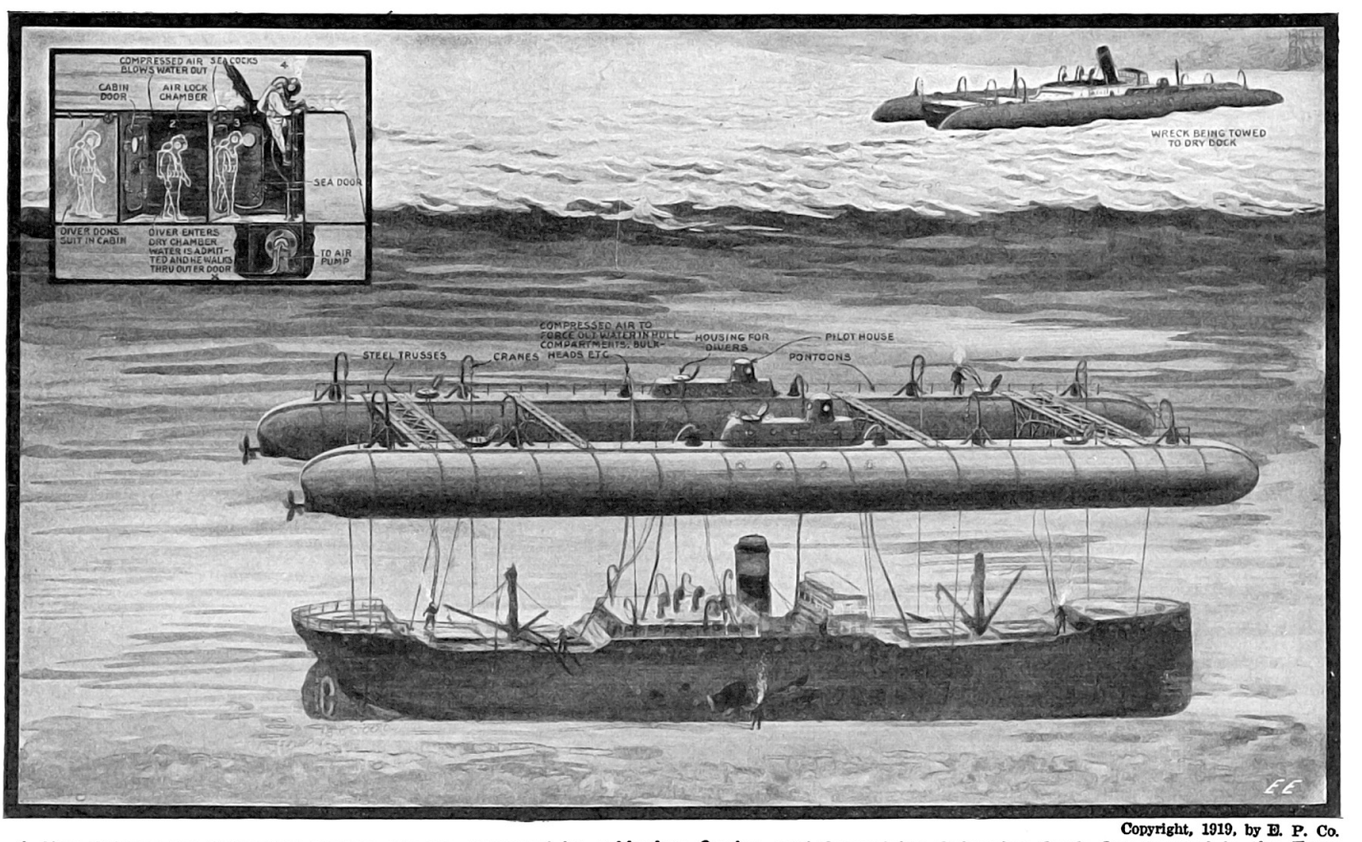
H.GERNSBACK – EDITOR
H.W.SECOR-ASSOCIATE EDITOR

Vol. VII. Whole No. 80 December, 1919 No. 8

Submarines to Salvage Sunken Ships

THE submarine proved to be one of the most effective and formidable sea devices ever conceived during the course of the World War, and now a Yankee genius, Mr. George Wall, comes forward with a peace-time suggestion for utilizing the principle of the submarine to raise some of the thousands of ships sunk during the war.

The accompanying illustration shows Mr. Wall's suggestion in practise. One of the basic principles underlying this new *submerging-pontoon* salvaging craft, is that of the great buoyancy produced when such a large air-tight chamber as a submarine is filled with air while submerged. The lifting power or buoyancy of such a pontoon of the size of a submarine, is tremendous, especially when it may have a length, let us say, of from 500 to 600 feet. These pontoons could be submerged to any depth while seeking the wreck, in the same manner as submarines submerge, i. e., by admitting water into the submerging tanks. When it is desired to rise to the surface, this water is blown out of the ballast tanks by comprest air.



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A New Scheme for Salvaging Sunken Vessels Proposed by a Yankee Genius, and Comprising Salvaging Craft Constructed in the Form of Gigantic Submarines, Which Can be Sunk When Desired and Their Immense Buoyancy Utilized in Lifting the Wreck.

TWO SUBMERSIBLE PONTOONS USED

The submarine-pontoon of which two or more may be used in raising an ordinary size vessel, are not tied together mechanically, but may be anchored to each other when desired, by means of steel girders. A number of powerful, motor-operated derricks are placed along the decks of the salvaging pontoons, and from these a series of steel cables depend downward. At the start of the salvaging operation on the wreck, divers are employed to pass cables around under the hull of the boat. The free ends of these cables are caught and brought up to the surface where they are fastened to the lifting derricks of the second pontoon.

Such a salvaging outfit possesses many advantages over the surface type of craft, which cannot submerge, and under many salvaging conditions it is often impracticable to lower a diver down to the scene of the wreck, owing to the long lengths of air-hose, hoisting cables, etc., which have to be used. With the present invention, it is possible whenever necessary, to submerge the pontoons and keep them submerged the same as any ordinary submarine, for several hours. These pontoons may be fitted with powerful electric

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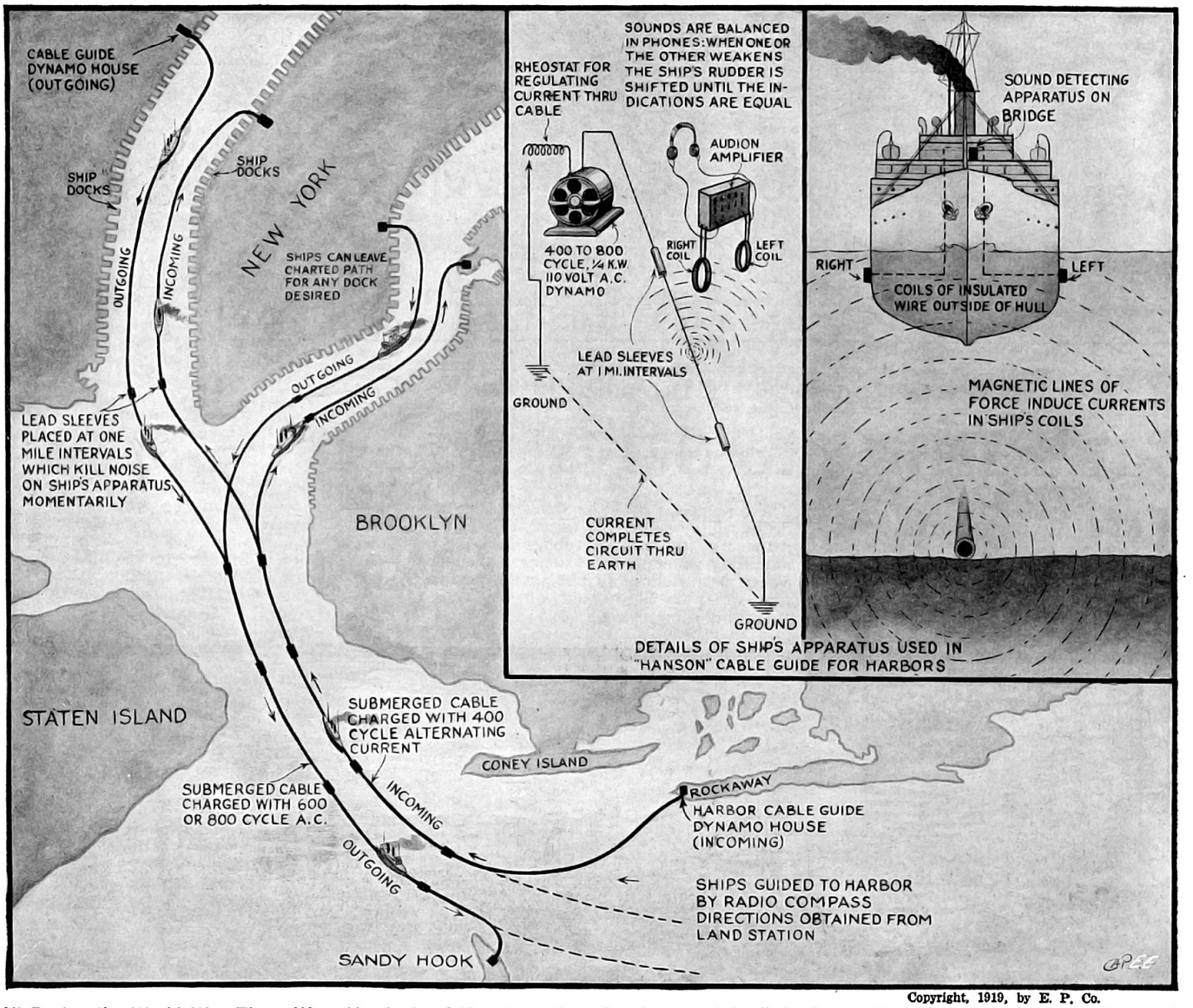

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All During the World War There Were Hundreds of New Inventions Developed and Applied. One of These Was the "Hanson" Electrified A.C. Cable, Buried in the Mined Regions Where Our Ships Had to Travel. By a Suitable Listening Device Aboard the Ship the Navigator is Enabled Instantly to Ascertain Whether or Not He is Out of the Proper Course. A Great Stunt for Foggy Weather.

Ships Guided by Electrified Cable

THE marvelous "fog tamer" invented by Earl S. Hanson, a young Los Angeles scientist, is to be thoroly tested by the Navy Department, it is said. The Hanson invention marks an important step to make practical what has been called the greatest development in marine travel since the discovery of the steam turbine.

Mr. Hanson's device makes it possible for steamships to navigate any channel with perfect safety, no matter how winding or treacherous, thru the heaviest ocean fogs or under the most adverse weather conditions. It will prevent the tying up of shipping outside of harbors while vessels wait for the weather to clear so that they can navigate the channel. Steamship service between New York, Liverpool, Brest, Southampton, Cherbourg and other channel ports will be as regular as railroad passenger trains arriving in the giant terminals of New York.

Tests will be made at once at the naval base at New London and later a greater test with some of the biggest liners of the world, such as the *Leviathan,* will be made in Ambrose Channel, New York harbor. Material has been shipt to New London for the first test and men have already been detailed for this work. As soon as the official tests prove satisfactory all the great ports of the United States will be equipt by the navy with the device to defy fog, hail, rain, snow and sleet.

By the use of the new invention in connection with the radio compass which the navy has now perfected, all danger or delay in ocean travel due to weather is absolutely eliminated.

The radio compass brings all shipping in sight of land and the new device, like a friendly hand, reaches out and takes the biggest of ships thru the most tortuous channels safely and quickly to its pier.

The new device is simplicity itself. A cable is laid in the center of the ship channel. Thru it is sent an electric current of low frequency which thru the listening devices on board ship gives off a sound of certain pitch that cannot be mistaken for any other sound. The ship hugs the cable from harbor line to the dock. On the bridge and in the captain's cabin listening devices like telephone receivers are placed and attached by wires to the hull of the ship. The ship follows the course of the cable. Any variation away from the cable is indicated by visible indicators (sensitive galvanometers connected in the receiving coil circuits), which show in feet the distance away from the cable, and the ship is then put back over the cable by the steering rudder in the usual way. By the ear receivers the indicator may be confirmed at all times.

Vessels going into port will use one cable; those coming out another. *The sound on each is different* and there can be no confusion and therefore no collision.

Along the cable, at mile intervals, a section is sheathed with lead. Thru this no sound can come and therefore the man on listening duty can tell instantly how far the ship has progrest, and by the cable chart in front of him, can tell where the cable turns and where the ship must be steered to follow the curve of the cable and the center of the channel. The new device, according

(*Continued on page* 831)

Did the Romans Have "Wireless"?

"WIRELESS telegraphy is new; wireless communication is as old as Biblical times." With this trite statement the National Geographic Society quotes from a communication by John A. Kingman, who sets forth the interesting theory that the island of Capri was an imperial wireless station of ancient Rome.

"We know that the ancients signaled in various ways and over long distances," he says. "They signaled by beacon fires, by beacon smoke, by pigeons, by flags, and by shouting from one sentinel to another.

"Lighthouses are as old as the earliest chapters of the Bible. Beacon fires and beacon smoke were commonly used by the early Greeks, and there was no reason why the more practical Roman should not have employed inproved methods, such as *heliographing*.

HOW ROMANS USED GREAT MIRRORS.

"We do know that at the siege of Syracuse by Marcellus mirrors were employed by Archimedes; and tho we may doubt the burning of vessels from shore by mirrors, as stated on that occasion, we can appreciate the blinding effect of many mirrors on the eyes of the navigators of the attacking vessels. That is what probably happened during that conflict. At any rate, it shows that the great Archimedes, at least, had found some use for mirrors other than the usual one.

"In Imperial times the Romans had mirrors large enough to reflect the entire person; they even had mirrors of glass backed with tin instead of quicksilver.

"Signaling was certainly a common military practise among the ancients, and ancient writers, such as Virgil, Aeschylus, and Herodotus, frequently alluded to it.

"An interesting case of long-distance signaling by relaying is mentioned by Herodotus, in which it appears that certain tidings were sent to Xerxes in Asia by means of a line of beacon fires arranged thru the Greek islands.

"The ancients went further than simply announcing some prearranged message; they had codes and sent long messages. The Greeks signaled on one occasion 100 miles at one jump. This was from Mt. Chigri, 1,698 feet, to Mt. Athos, 6,500 feet.

"Gallup's Hand Book of Military Signaling states that 'under favorable conditions the distance to which messages may be sent and received is only limited by the curvature of the earth'; also, that 'square mirrors are better than round ones only because they contain about one-quarter more reflecting surface for the same packing space.' Round mirrors are used now. Mirror signals have been seen with the unassisted eye at distances of 160 miles. While this is, perhaps, a record, and tho there is no statement as to the size of the mirror, it probably did not exceed twelve inches square.

"The reasonableness of the Capri 'wireless' station theory tempts one to speculate as to how much signaling was done and how it was done. It will be remembered that Tiberius, the unpopular successor of Augustus, spent eleven years of his reign on Capri, and without coming to Rome directed most successfully the affairs of the vast empire. He even foiled the conspiracy of his trusted minister, Sejanus who was supposed to have general charge of affairs after Tiberius retired to the island.

"Tho Tiberius went to Capri, an old man, he was the actual ruler—emperor, in fact—and his heavy hand was felt all over the empire until the very end. With regular news bulletins and reports, received daily if need be, containing confidential information, he would be able to issue instructions and manage affairs as thoroly as if he were in Rome.

"Possibly the *Publica acta* (Senate Journal) and the *Diurna acta* (authorized news) were sent to Capri by signal instead of by messenger. We can conceive that such a system, organized most likely under Augustus, must have operated very smoothly after some years of experience and practise. I hazard the theory of mirrors because of its simplicity and convincing character. Signaling by beacon seems too primitive for the wonderful civilization of the empire. Of course, at night-time beacon fires would have to be employed; mirror signaling was a fair-weather method.

"The distance in an air line between Rome and Capri is 130 miles—too long for direct signaling; but if we look along the coast of the Tyrrhenian Sea we find numerous mountains affording points where the signals could be relayed. The frequency of the relaying would depend on the conditions. The highest point on Capri is Monte

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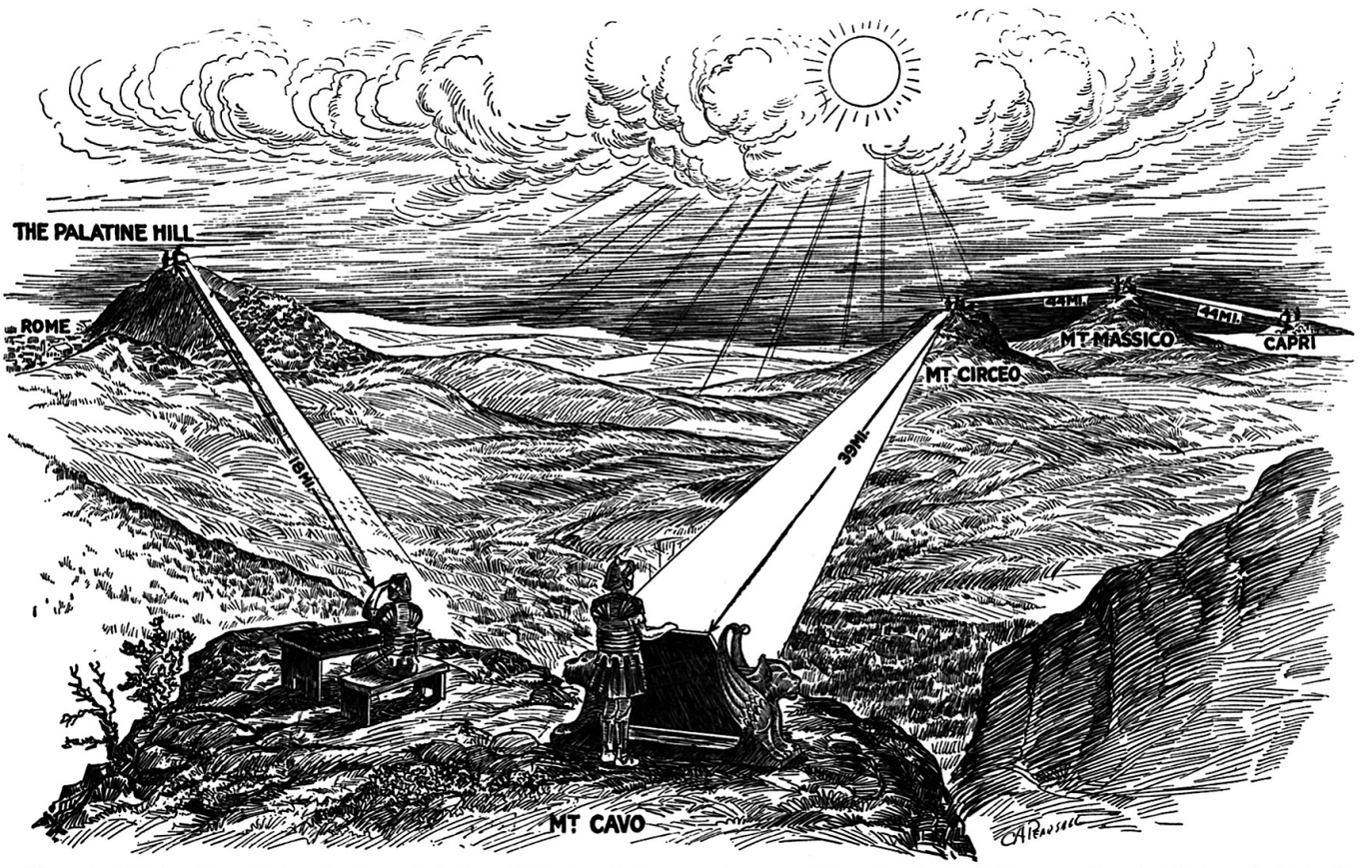


There Is Nothing New Under the Sun, Not Even "Wireless." It Now Appears That the Ancient Romans Already Had a System of Sending Messages Over Several Hundred Miles Merely By the Use of Mirrors,—a Sort of Heliograph. This Illustration Shows How It Was Possible to Telegraph from Rome (The Palatine Hill) to Capri, a Total Distance of 145 Miles. Our Illustration Shows How the Flashing of Signals Was Accomplisht During the Day Time. At Night, Fires in Front of the Mirrors No Doubt Were Used.

Thomas A. Edison Speaks to You

By H. Gernsback

MR. EDISON having kindly consented to speak to the readers of the ELECTRICAL EXPERIMENTER, an interview with the illustrious inventor had been arranged for during the latter part of October of this year.

This interview, by the way, has some history attached to it. During the early part of 1917 a similar appointment had been made to interview Mr. Edison on the same subject. But just then the great war broke out and Mr. Edison, who, as is well known, was immediately appointed the head of the Naval Consulting Board, broke off all engagements, devoting himself day and night to the welfare of his country. For this reason the interview only took place a few weeks ago.

THIS is the first interview which Mr. Edison has given out for some years past.

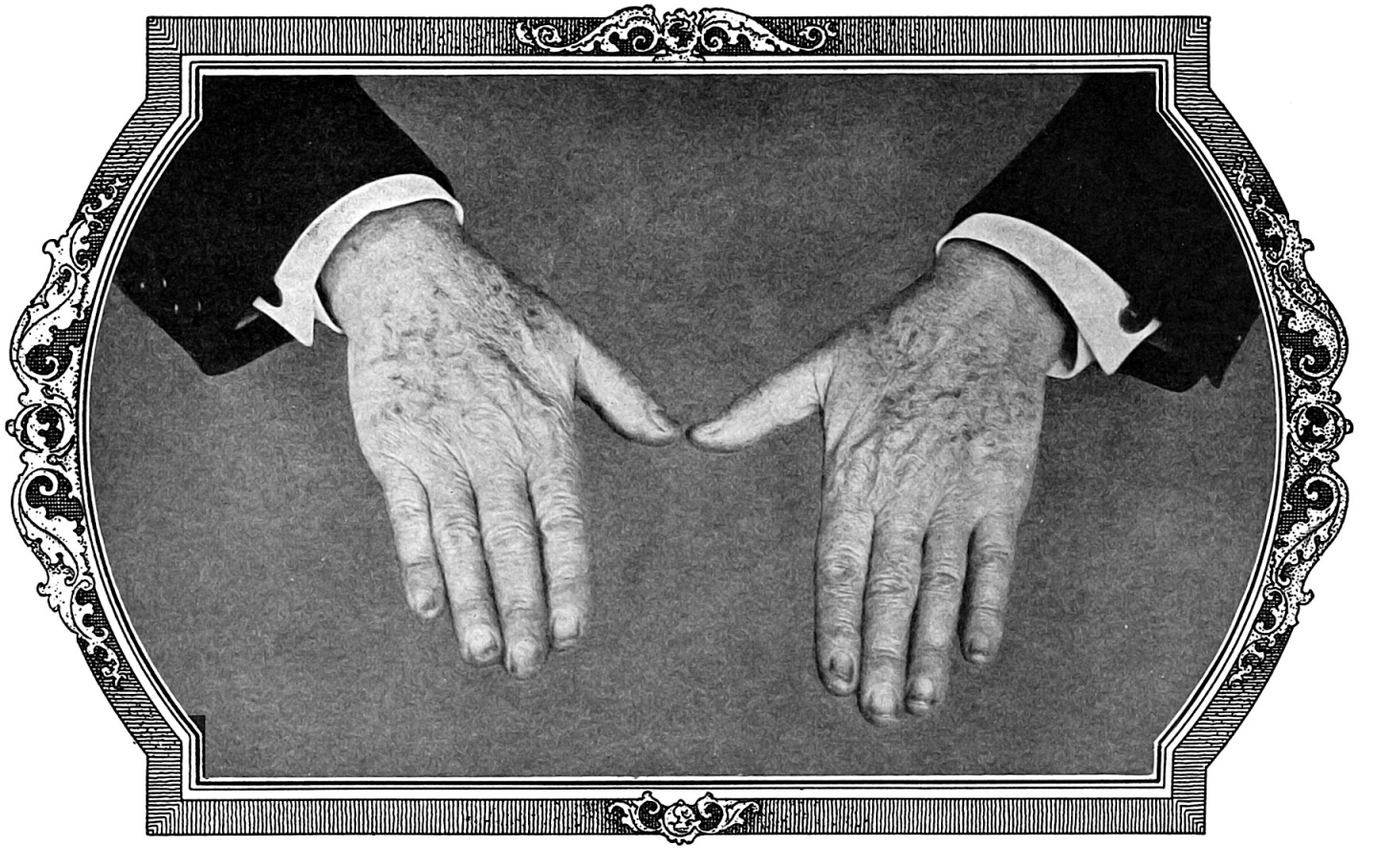
Mr. Edison, who, as is well known, was elected Chairman of the Navy Consulting Board at the outbreak of the world war, was taken up with important duties, refusing to see all visitors. Even several years before this, no general interviews were given out. In this story are covered many points of interest not only to all experimenters and the man interested in science, but to the world at large. Much that is new has been presented here, and it will be noted with satisfaction by all that at the age of seventy-three, Mr. Edison's mind is as keen and clear as ever. We are certain our readers will appreciate this important article. Nearly all of the photographs and illustrations appearing in this story have never been publisht.

I ARRIVE AT MR. EDISON'S LABORATORY.

I arrived at West Orange on a crisp October morning and was soon in the little gate house which protects Mr. Edison from a curious public. Plain and modest as it is, the little red house has past thru its gates hundreds and thousands of the world's most famous men and dignitaries. Few such modest little houses, if any, have held under their roofs such an array of famous people who have come to pay homage to one of the greatest inventors the world has ever known.

In this little gate house is located the famous time clock on which Mr. Edison rings in his time and rings out every day of the year, many holidays included. An inspection of his week's time card revealed that Mr. Edison had invariably been at the laboratory before 8 o'clock in the morning and had worked as many as eighteen hours for three days at a stretch. Only once did he have a twelve-hour day. Right then and there I wondered how Mr. Edison felt about the now so popular eight or six-hour day, and I meant to ask him about it, but we became so engrossed in other more important questions which are moving the world, that altho we touched upon this subject, the eight-hour day question was never broached by me.

After passing thru the gate house, I made my way to Mr. Edison's library, where I was welcomed by Mr. W. H. Meadowcroft, his trusted and capable friend and secretary. While waiting for Mr. Edison, who was just then engaged with some chemical experiments, Mr. Meadowcroft pointed out all the interesting objects of Mr. Edison's library. This library is a huge affair and, besides containing electrical, chemical and physical reference works printed in almost any imaginable language with English, French and German predominating, many other curiosities are to be found here. There are many dozens of autographed photographs of famous men hanging about the walls, as are famous historic photographs portraying this or that view of an important phase of Mr. Edison's great discoveries, such as the electrical traction, the electric light, the phonograph,



The Only Authentic Photograph of Mr. Edison's Hands Ever Taken Publisht Here for the First Time. The Spots on the Hands Are Chemical Stains Which Could Not Be Washt off at the Time the Picture Was Taken. IF THE WORLD WERE CALLED UPON TO MAKE AN INVENTORY OF WHAT MR. EDISON'S HANDS ACTUALLY WROUGHT IN ENRICHING THIS PLANET, THERE WOULD NOT BE GOLD ENOUGH TO PAY HIM.

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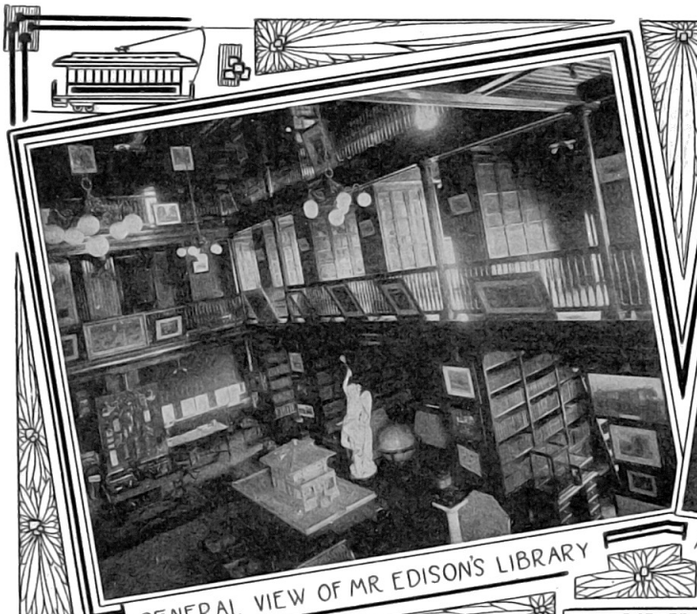
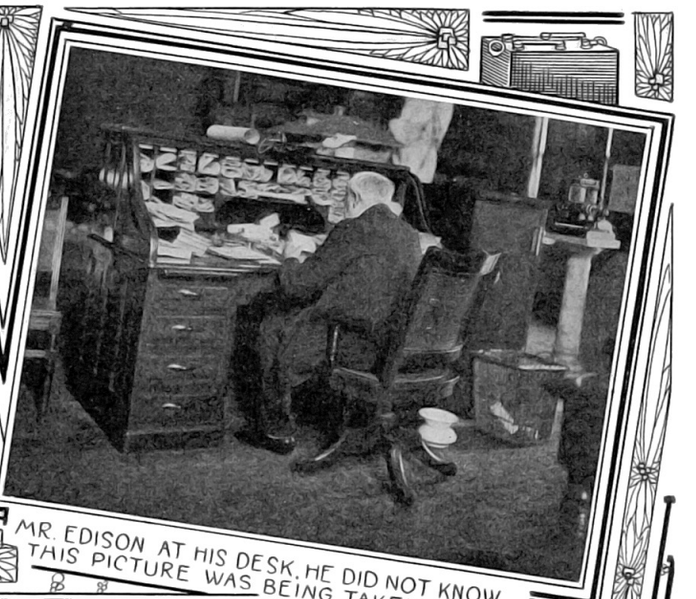
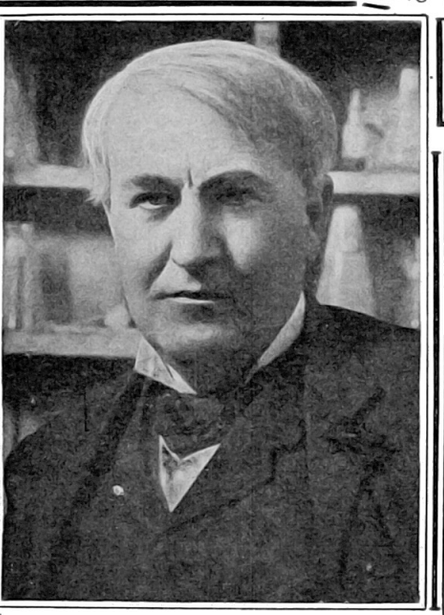


GENERAL VIEW OF MR EDISON'S LIBRARY



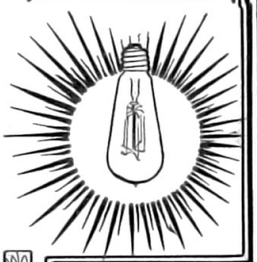
MR. EDISON AT HIS DESK, HE DID NOT KNOW THIS PICTURE WAS BEING TAKEN

MR EDISON AND "BLUE DEVILS" SUMMER OF 1918



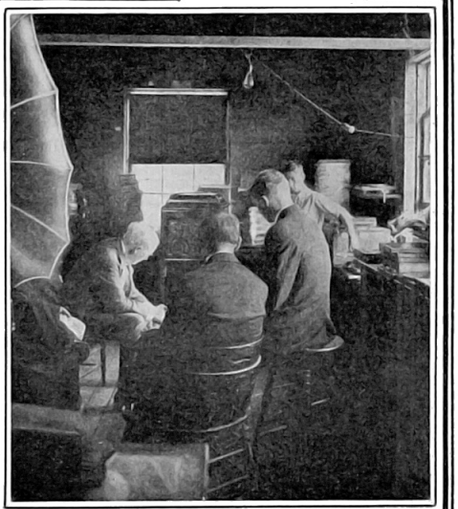
MR EDISON'S FAVORITE PICTURE TAKEN A SHORT TIME AGO

CUBIC FOOT OF COPPER IN MR. EDISON'S LIBRARY BY TIFFANY

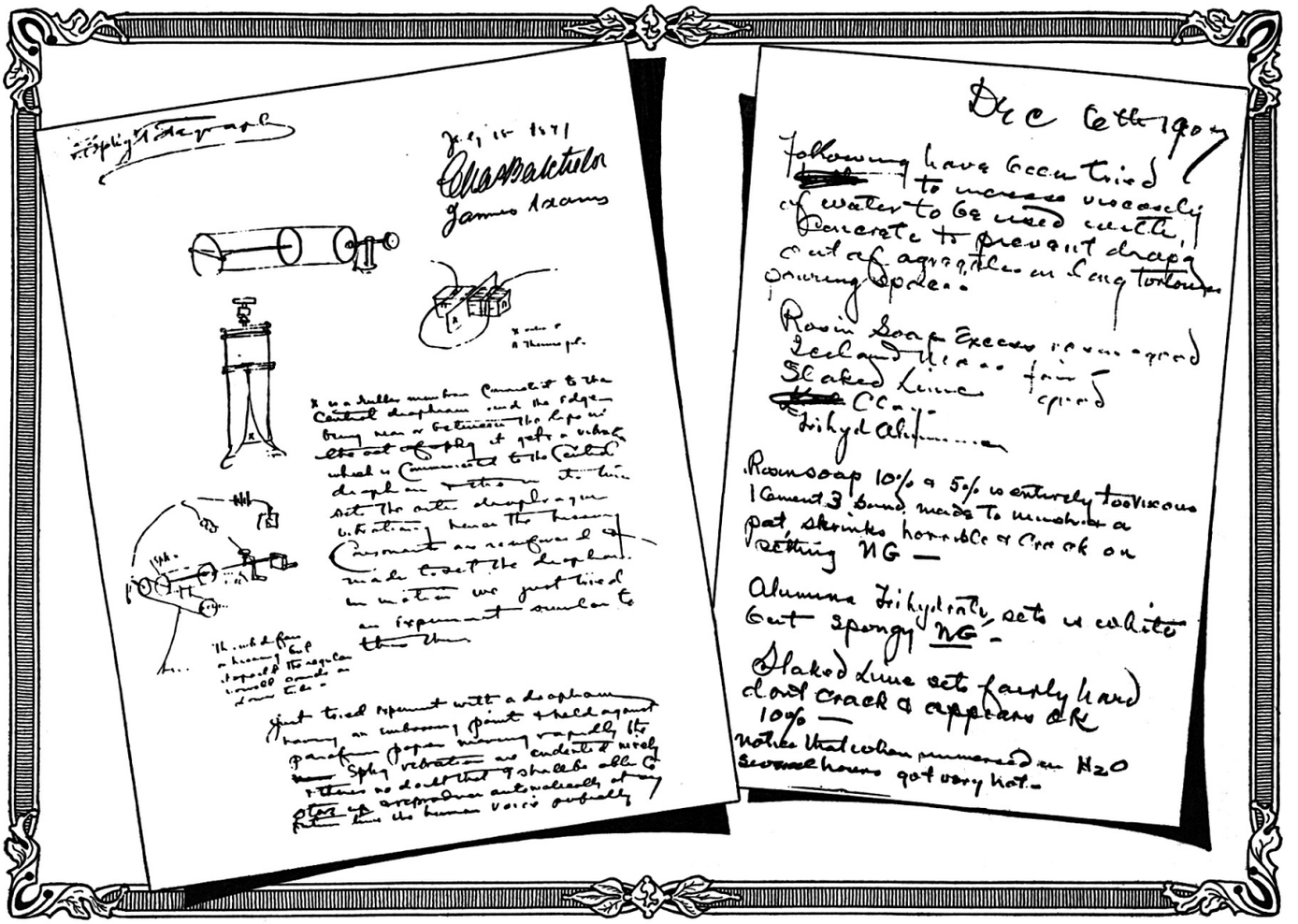


STATUE ON MR. EDISON'S LIBRARY "TRIUMPH OF ELECTRIC LIGHT OVER GAS"

MR. EDISON THROWING FIRST BALL AT BASE BALL GAME ON EDISON FIELD DAY



MR. EDISON WITH ASSISTANTS LISTENING TO PHONOGRAPH RECORD



The Illustration at the Left Shows a Photographic Reproduction From One of Mr. Edison's Note Books. It Is Nothing Less Than the Now Historic Proof of the Invention of the Phonograph. It Shows the Conception of the Idea Plainly. On July 18, 1871, Mr. Edison Was Making Some Experiments Which Had Nothing To Do with the Phonograph. As a Matter of Fact It Seemed To Be More or Less Nebulous In His Own Mind, for at the Top of the Page He Wrote "Speaking Telegraph." The Part of Interest to History Is Found in the Foot Note of the Page, Which Reads as Follows:

"Just Tried Experiment with a Diaphragm Having an Embossing Point and Held Against Paraffine Paper Moving Rapidly. The Speaking Vibrations Are Indented Nicely and There Is No Doubt I Shall Be Able to Start Up and Reproduce Automatically at Any Future Time the Human Voice Perfectly."

Note Also the Two Witnesses' Names Under the Date, at Top of Page. The Other Page Shows a More Recent Sample of Mr. Edison's Handwriting. It Is From One of His Memorandum Books and Is Dated December 6, 1907. Note How Much Attention Mr. Edison Pays to Record Even Trivial Experiments, Also His Characteristic "N. G." In Two Places. The Changed Handwriting After an Elapsed Time of Thirty-Six Years Is of Great Interest.

the moving picture and many others. A huge white marble statue immediately catches the eye. Mr. Edison brought this from Paris at the time of the World's Exhibition in 1889, it having caught his fancy. The marble figure represents a boy seated upon a broken gas lantern, holding aloft triumphantly an electric light. Another object of recent dating is a solid cubic foot of copper weighing several hundred pounds mounted upon a mahogany pedestal. This solid piece of copper, made by Tiffany and suitably engraved, was presented to Mr. Edison by the copper interests of this country as a tribute to the great inventor. This symbolic gift can be better understood when it is realized that fully 50 percent of most of this copper is used for lighting purposes, which art was founded by Mr. Edison.

In this library I also inspected the famous "bed" upon which Mr. Edison catches a little sleep when he is engaged in day and night work at the laboratory. This cot is a very prosaic affair, and is located in the corner of the library amidst books and other curios. It is a bed in name only, for it is comprised of nothing but a mattress, pillow and a blanket.

On one of the walls, we also find a complete history of Mr. Edison's Alkaline Storage Battery, exhibited on a large wall board. This is graphically shown by displaying every part, chemicals included, that go into the making of this famous non-lead battery. The thing that most interested me in Mr. Edison's library, however, were his notes, and right here we find one of the pregnant reasons for Mr. Edison's great success.

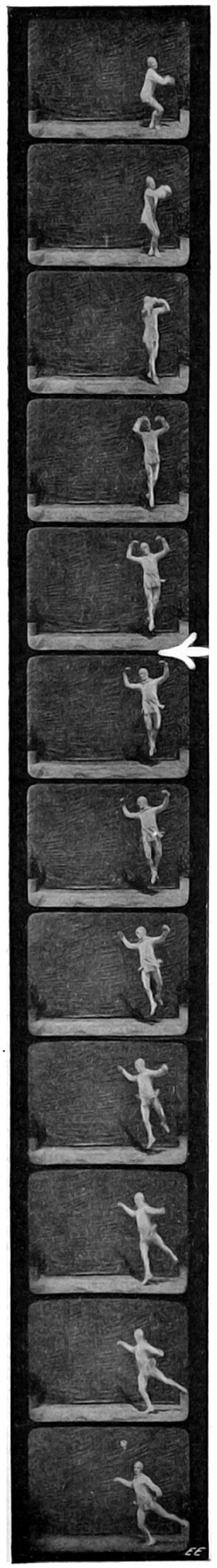
MR. EDISON'S LABORATORY NOTES.

As is well known, few inventors have made their inventions pay. They are usually "inventors"—and that is all. Mr. Edison, on the other hand, aside from being an inventor, is also an excellent business man. Mr. Edison is systematic and knows the value of notes. He won many a patent suit on account of his notes written dozens of years ago. Early in his career it was brought home to him that when you have an idea, a record should be made *at once!* This was so engrained into his system that it is almost an impossibility for him to make even the most trivial experiment without making a careful record of it. Mr. Edison writes his notes in pencil, and at the end of the day the notes are carefully put away. Each month these notes are bound into a book, where they are kept for further reference. The office staff card-indexes his experiments and cross-indexes them, so at any time Mr. Edison can readily find any one experiment he made during the month, or, for that matter, any experiment that he made 25 years ago, if necessary. The notes are invariably made on yellow paper on ordinary scratch pads, the pages measuring about four by six inches. Being systematic, Mr. Edison always uses the same size pad year after year, and it is therefore refreshing to see the same sized sheets, and the same kind of paper made into bound volumes. While I was still inspecting some of these note books, many of which contain priceless data, Mr. Meadowcroft was informed by telephone that Mr. Edison was ready to receive me.

We walked across an open space separating the library from the chemical laboratory, and Mr. Meadowcroft explained that the building in which Mr. Edison was working that day was known as the chemical laboratory. Mr. Edison, however, does not work in the same laboratory all of the time, but for the past

(*Continued on page* 802)

"Slow Movies" Analyze Motion



THIS camera is known as *Novagraph*. and is an ultra-speed camera According to its inventor, Mr. Charles Watson, it is the result of years of hard study and costly research work, together with intense concentration and experiment. The camera is "cranked" the same as any ordinary motion picture camera, i.e., by hand, and exposes the film to the subject at the rate of 160 *exposures per second*, as compared with the usual *sixteen exposures* of the ordinary motion picture camera taken in the same interval of time. In projecting the film at the normal speed, sixteen pictures per second, the audience views the screened picture *slowed down to one-tenth the usual rate*, thus affording a perfect eye analysis of every motion of the subject. One hundred and sixty exposures per second does not mean that this is the maximum speed at which this camera can be operated. At any time the exposures, if need be, may be speeded up to 200 per second, or even 300, if necessary. In this case, however, the projection would be unduly slow, and quite unnecessary for making the essential analysis of ordinary motion. Needless to say, this camera is of enormous value, and its value lies particularly, perhaps, in its efficiency in scientific work. By means of the Novagraph, wonderful photographs of surgical operations have been taken, and the dexterous manipulation of instruments is made so clear that even an amateur is prompted to attempt the skilled operator's work The Novagraph recently played an important part in taking photographs of heart actions and medical subjects, at which time Dr Samuel W Lambert, late Dean of the College of Physicians and Surgeons, Columbia University, exprest his highest approval of the wonderful work of this machine and immediately recognized the opportunity of the "slow" motion picture camera in medicine and surgery. At the Convention of Physicians and Surgeons in June at Atlantic City, members from all over the world were tremendously impresst with the above-mentioned motion picture. So much so, that Dr. M. C. McBride stated that never before had the members of the audience broken out into such spontaneous and tremendous applause.

Photographs were taken of the heart and lungs, in which case the movement of the oricles and ventricles of the heart were brought out so clearly that it seemed as tho the heart were being moulded into its various forms. Every little spasmodic contraction was instantly noticeable, and the analysis of its motion rendered complete to the finest detail. Twenty-pound bulldogs were used in conducting these experiments, and as daylight was not powerful enough to enable the camera to attain its best results, 7,200,000 candle-power Sunlight arcs of the new Sperry design were used.

The Advent of the "Slow Movie", as It is Called, Has Clarified for Us Many Hitherto Foggy Scientific Facts. Did You Know That It is Possible for a Running Horse to Get All Four Feet Off the Ground Simultaneously? How Does the Heart Look While Beating? Is a Man or a Woman the Most Graceful Swimmer? All the Views at Right Were Taken by the "Novagraph" Camera Between Two Successive Exposures of the Ordinary Movie Film Shown at Left. The Slow Movie Camera Catches Details Which the Regular Movie Never Shows.

Five hundred feet of film are run thru this camera in forty-nine seconds! Ordinary film traveling thru the camera at this rate would instantly burn up. Hence specially treated film must be used.

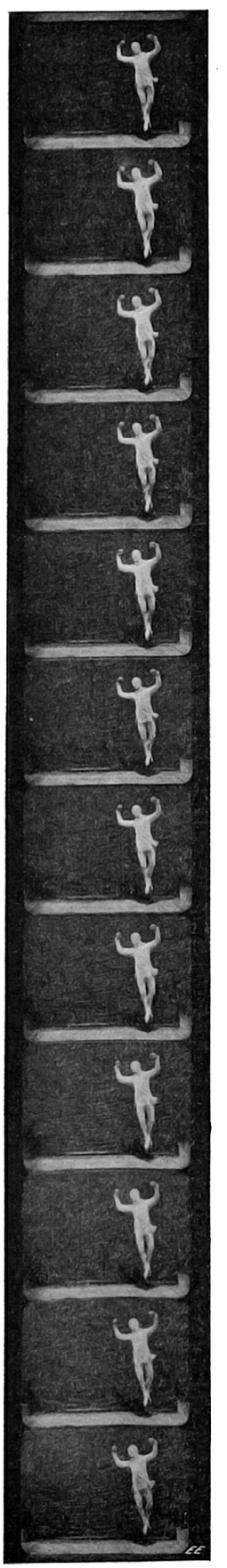
In the taking of slow motion pictures it is the general rule of the director to have two cameras placed side by side, the Novagraph and ordinary commercial camera, both cameras trained upon the same subject; the film is then "shot" at the same time. The positives of these films are then cemented end on end. Immediately on projection of the film taken by the ordinary camera, a small sub-title telling of the appearance of the same picture, but taken at the ultra-rapid speed, introduces the Novagraph *detailed analysis* picture on the screen.

In one case a famous billiard artist had photos taken of some very fancy and difficult shots—one in particular being a billiard ball leaping from the table into a wicker basket. When this photograph was taken with the ordinary camera the ball appeared in one frame only. With the Novagraph, however, which was taking pictures of the play at the same time, there were twelve such exposures, depicting the actual flight of the billiard ball into the wicker basket, proving that the Novagraph recorded twelve extremely rapid exposures to one of the ordinary camera. Very interesting pictures were made of the extent of deterioration of steel, and on photographing pictures when a test was being made of its tensile strength one could clearly see the breaking and rending of these steel rods Photographs of high explosives being used to blast rock were so distinct, and the analysis of the cringing movement and the shredding apart of these rocks were so clear as to make the ordinary layman express the greatest surprise that a blasted rock would cause such an intensely interesting scene.

A very peculiar phenomena happened recently in New Jersey. The high-speed camera experts were to take some interior photographs. When it came to the developing of these films it was found that the ordinary camera, which we said before always accompanies the Novagraph camera in the taking of such pictures, produced a most perfect film. In the high-speed camera, however, such was not the case. Every third film was absolute blank. *On inquiring into the cause, it was found that alternating current had been used for the illumination, and this camera had actually photographed the alternations of the current.*

We do not ordinarily perceive any alternations or pulsation in such a current which would be at once indicated by a distinct flick

(*Continued on page 796*)



Mysteries of Stage-craft

By H. Winfield Secor

How Electricity Makes Possible Modern Stage Wonders

IT is a far cry from the present-day theater, with its thousands of electric lamps which can be flashed on and off in the twinkling of an eye, back to the gas-lighted theater of our grandfather's time. The stage electrician of the present generation is king of all he surveys, and a king he truly is, for he can mar or make any theater production. Some of the interesting things which are actually being done on the stage today are described in the following article—electrical and mechanical and stagecraft tricks which the audience never sees.

REVOLVING AND ELEVATING STAGE FLOORS.

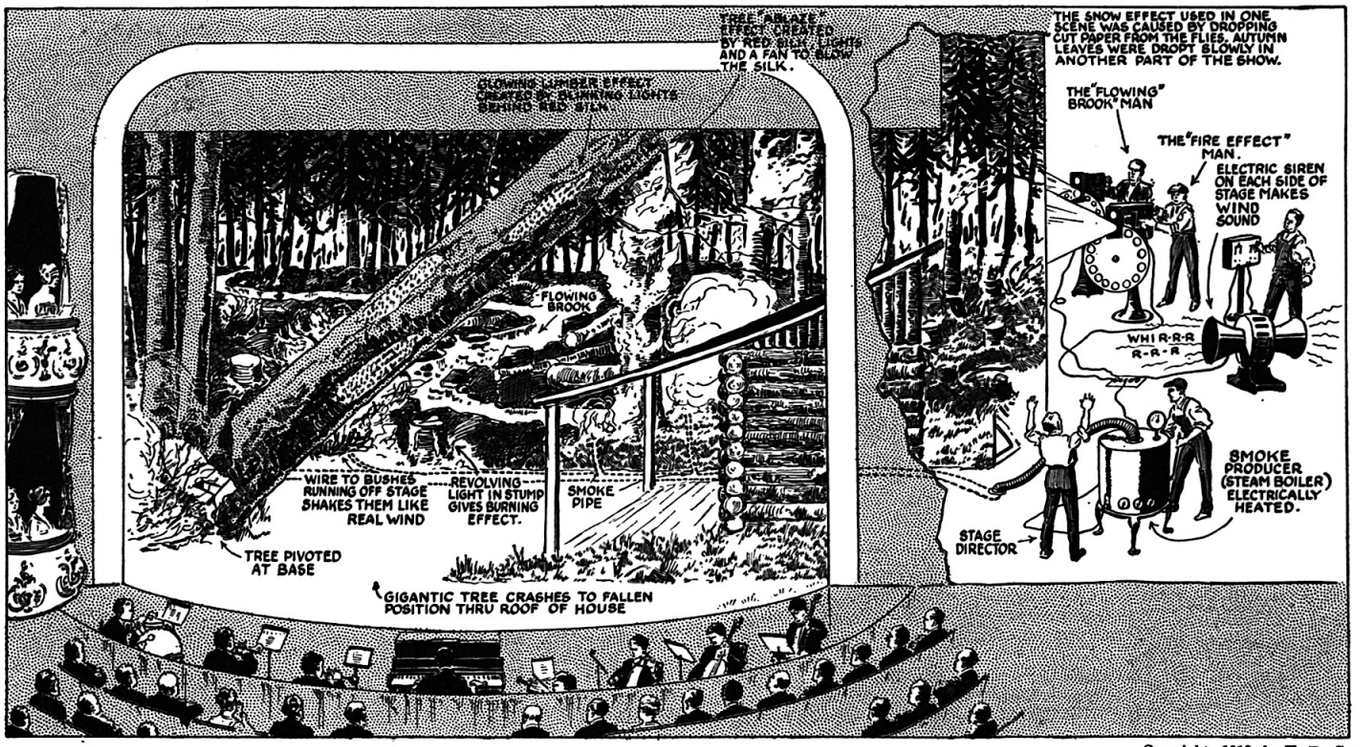
In order to expedite the change of scenes in the more elaborate theatrical productions, especially those having several different scenes to each act, many novel ideas have been developed and installed in several New York theaters, including revolving, as well as rising and falling stage floors. Three different forms of these movable stage floors, which enable several different scenes to be set up at one time, are illustrated at figures one, two, and three. Each of these three ideas, for providing multiple stage floors, have been actually tried out and proven successful.

Figure 1 illustrates a rising and falling stage in use at one theater. Two platforms, each large enough to carry the stage setting as shown, are built in the form of a gigantic elevator, the top platform being separated about 20 feet above the lower platform, with steel girders at the ends and at the rear, where they will not show in the setting. Under the lower platform, which normally is level with the basement floor, there is placed a battery of *hydraulic elevators*, which operate by water under pressure. For the second scene shift, scene No. 1 may be set on either the upper or lower platform, and the second scene brought to the stage level in a few seconds by the hydraulic elevators. That is, considering that a two-act show is being put on. With a three-act show or a production having several acts with many changes of scenes, then at the start, scene No. 1 would be set on the lower platform, while scene No. 2 would be set on the upper platform. When the curtain goes up, scene one appears before the audience, the setting of scene two being 20 feet above the stage. The lights are then winked off for a few seconds, or the front curtain is dropt for a moment and raised again, when, Lo! and behold! the scene has changed! How is it done? Simply by operating the hydraulic elevator cylinders and plungers to lower the platform structure, so that scene No. 2 which was above the stage is now level with it, and the lower platform containing scene No. 1 is level with the basement floor, where the scene shifters immediately get busy and remove the scenery of set No. 1, and dress it with the scenery for scene No. 3.

The revolving stage which is in use in one of the largest New York play-houses, which is necessary as this circular floor is of quite a large diameter, is illustrated in use at figure 2. Two, three, or even four scenes can be set up at one time on this revolving stage. Where an elaborate musical comedy or extravaganza is to be produced with anywhere from 10 to 15 changes of scenery, the convenience and speed with which the different scenes may be changed and the show run off, will be appreciated. The revolving stage is rotated when desired by a throw of a switch, controlling an electric motor which rotates the platform thru a powerful worm gear underneath the floor. The platform rotates on roller bearings.

At figure 3, there is shown the checker-board scheme of quickly changing the scenes in a show. In one scheme now in actual use, the scenes for the three acts are set up on the right, left and rear scene platforms, as shown. These platforms are mounted on substantial rubber-tired wheels, so as to make a minimum amount of noise when the scenes are changed. When act No. 1 has been placed, the curtain is dropt and the platform carrying scenery for this act is rolled to the right, and the platform carrying the scenery for act No. 2, is pulled into place. One of these sets, including the platform, is quite heavy, and while it can be shifted by a number of men, recourse is had to a series of ropes fastened to the platforms and also to a powerful electric motor winch in the basement, whereby any

(Continued on page 810)



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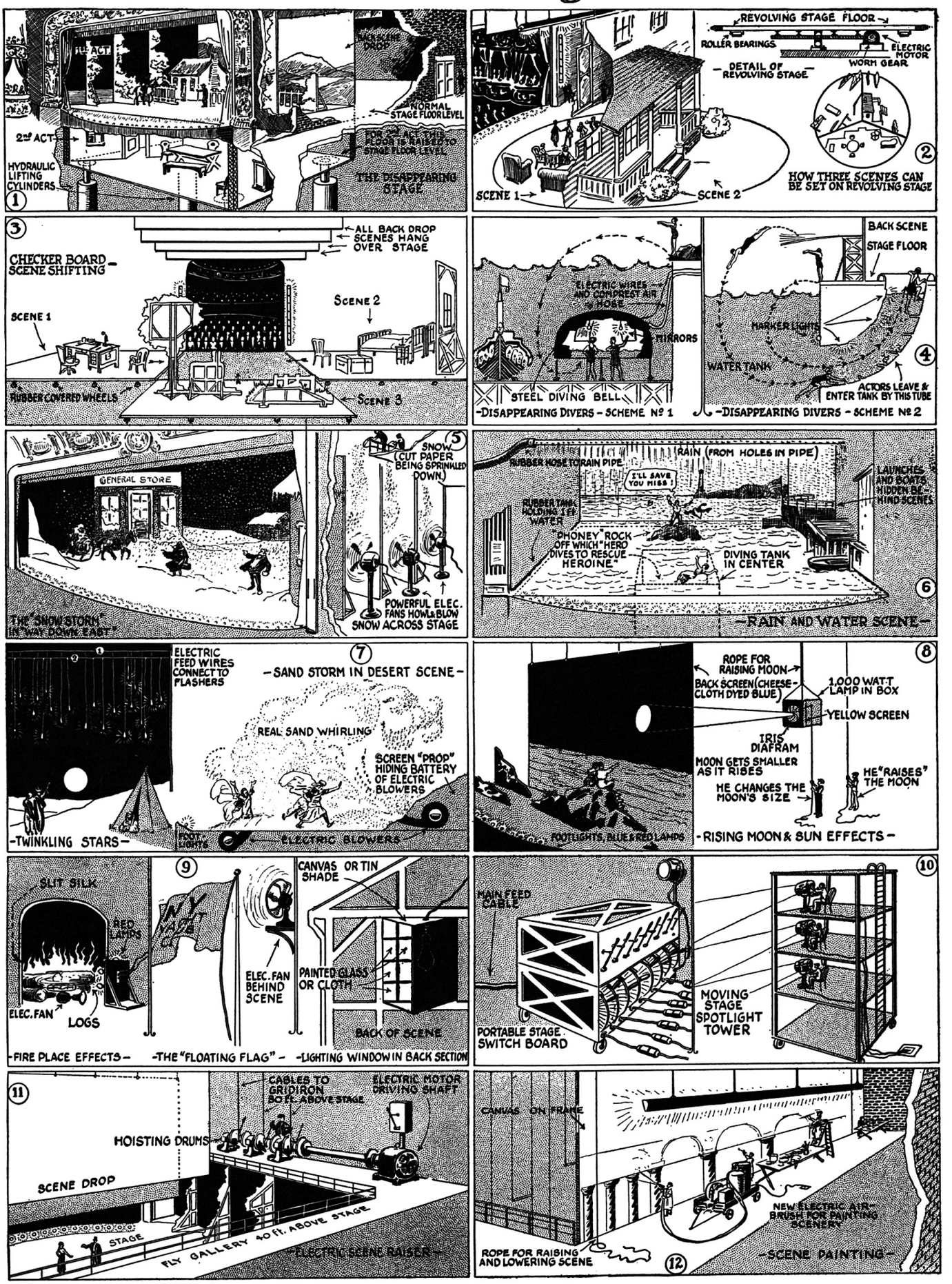
Scene from "The Storm" by Langdon McCormick, a Most Realistic New York Theatrical Production. In the First Act, There Is a Very Good Snow Storm Effect; the Bushes and Trees Swaying in the Wind as It Moans. At the End of the Third Act, the Audience Is Treated to One of the Greatest Masterpieces Ever Produced in Stage Settings,—a Sure-enough "Forest Fire" with Crashing Trees and Howling Wind,—and Not One Speck of Real Fire on the Whole Stage. In This Sensational Scene, the Fire May Be Seen to Creep Slowly Thru the Trees in the Distance. As It Gains Headway the Flames Leap Higher and Higher Until the Whole Stage Is Enveloped in Flames. Trees Fall, the Bushes and Underbrush Sway in the High Wind, and the Largest on the Stage, as Shown Above, Crashes Thru the Cabin Occupied by Burr Winton and David Stewart. The Incandescent or Burning Wood Effect on the Trunk of the Trees, Is Created by Electric Lights, Suitably Camouflaged Behind Colored Silk, Etc. Those Lights, Blinking on and Off, Enhance the Effect. Powerful Electric Sirens Produce the Wind Noise and the Creeping Fire Thru the Trees in the Distance Is Projected From Back Stage on to the Back Drop by Special Lanterns Provided With Moving Colored Discs.

Mysteries of Stage-craft



Complete Story on Opposite Page

An Aerial Passenger Rocket

OUR pleasure resorts and summer amusement parks have for many years tried to satisfy the whims of the proverbial "tired business man" and his family, not to mention the millions of others who flock to the great amusement parks at Coney Island and other national play-grounds scattered thruout the country. There are many hair-raising surprises to be found at all of the large amusement parks—such as scenic railways with dizzying inclines down which the passenger-laden cars rush at speeds greatly surpassing those of our fastest express trains, while the passengers proceed to yell and scream their delight as they dash at two-mile-a-minute speed into a pitch dark subterranean cavern made out of papier-maché with the aid of a glue pot, and then decorated by some clever artist to resemble a smaller member of the Rocky Mountain family. But aside from the steel-nerved lady and gent who have in the past few years delighted thousands at the big three-ring circus by looping-the-loop in mid-air in a real automobile or on a bicycle, there haven't been any real hair-raising and startingly new novelties produced in the Amusement World. The illustration here presented, shows a newly proposed amusement-park feature, which smacks decidedly of the essence of war, and while old man Mars and his spiked club, so familiar to our war-time cartoonists, has disappeared from favor in our national family life today, we hope, in fact we know, there is still a small fraction of the war-time spirit burning in the heart of everyone. So those who still think now and then of the war and some of the great deeds performed and the gigantic death-dealing machines developed during that period, will be interested in this new "Aerial Passenger Rocket" amusement device proposed by H. W. Secor and H. Gernsback of New York City.

You board this aerial passenger shell or rocket, on the ground, after which you are "loaded" by a powerful hydraulic plunger into the base of a gigantic comprest-air or electro-magnetic gun, which hurls you skyward with bewildering speed. The next moment you find yourself flying thru space with all the sensations of being imprisoned in one of the ex-Kaiser's dainty ltitle 42 C.M. shells, hurtling thru the upper air strata on its 70-mile journey toward Paris. The greatest pleasure of a trip in the new aerial passenger rocket is yet to come however. The next phase of the journey, all of which occupies the space of but a few seconds, so far, is when the passenger-carrying missile strikes the great mound of water at the top of the race-way or track, shown in the illustration. The water acts as a cushion, and prevents the shell from striking with a disagreeable jolt. All the while you, as a passenger, have been enjoying one of the most novel sensations of your life, thanks to the double-pivoted chair mounted on gimbal rings, and provided with a weight which stabilizes the chair constantly in a vertical position, and now you find yourself dashing earthward with express-train speed down a hollow steel raceway, along which the water discharged from the fountain at the top travels in its journey to the lagoon below. Directly you strike the water in your downward rush, there is a mighty splash as you strike the water and dash thru it, guided by the curved steel rails, until you return around the loop on your journey toward the starting point. As the shore of the lagoon is reached, the pasesnger-laden missile, acting under its own momentum, or else aided by a belt or link conveyor, such as used on scenic railways, is loaded onto electric cars of the type shown, which carry it along the track to the debarking station. Here the aerial rocket is unloaded and new passengers get aboard. The doors are closed and the human skyrocket starts on its journey toward the mouth of the "gun" once more. By proper design of the whole affair, it is possible for several rockets to be employed, the gun firing them at carefully timed intervals, a fraction of a minute apart. Of course, if one of the shells happens to get stuck on the water chute, and shell No. 2 comes sailing thru space directly behind it, then of course there will be a collision,—but that is nothing, for did you not start out to have a real sensation?—and you will have one sure enough, just the same as those you read of during the war, when one of the Hun's mighty shells and a French shell met in mid-air. Yes, this looks a little bit like a real accident, something on the order of the physicist's classic—"When an irresistable force meets an immovable body . . . . . etc."!!!??

Putting aside the smaller details, such as what kind of grease to lubricate the gun and what color to paint the projectiles, altho the inventors would like to see red, white and blue stripes painted along the tips of the shells, pointing rearward, we now come to some more serious problems. One of these is: What kind of a gun or projecting device can be used to hurl the shell skyward with possibly eight to twelve passengers with not too great a velocity, such as 12 K.M. per second, which would hurl the projectile away from Mother Earth so fast that little Johnnie and his sister would never come back to earth again to see Ma and Pa? Further, it should have enough speed to make the shell follow a carefully calculated trajectory, taking into consideration the ballistics of the air, and of course, the wind pressure, etc., all of which our able artillery officers are wont to tell us they have boiled down to such an exact science, that they can hit the head of a pin with a twelve-inch shell ten miles away.

As we were saying, this is one of the big problems, and four methods are proposed, at least one of which should certainly prove practicable, providing a rich Croesus from New York or some other well-known monetary mart, gets up enough nerve to back this invention, and if he cannot be found, it may be suggested that at least one of the inventors has signified his willingness to make the first trip, when the aerial passenger rocket shall have been built. Four ways in which the rocket can be projected heavenward with sufficient speed, are as follows:

First: An electromagnetic gun or steel tube around which are wound a number of magnet coils, each of which is successfully and progressively connected with a source of electric current, so that the steel body of the projectile will be sucked forward at ever-increasing speed in a well known manner, which has been described a number of times in the ELECTRICAL EXPERIMENTER.

Comprest air forms the basis of a second method for forcing the projectile thru the tube at high velocity, and a comprest air plant and tank are shown in the present illustration, which in any event would prove a worth-while auxiliary source of power for operating the device.

Gun powder used as a source of power to project the rocket upward thru the tube, would provide a fine spectacular effect at night, and in the day-time, the noise of the successive explosions, as the shells popt skyward one after another, would prove an excellent drawing card, but perhaps no passengers.

A fourth scheme may utilize the well-known belt with spurs on it, similar to that used in scenic railways at the present time, or some other form of modified rapidly moving belt can be devised which would rapidly carry the projectile skyward. This scheme may seem impractical and something that cannot be realized in a commercial way, but if it is possible for a person in an automobile to loop-the-loop in mid-air as has been done, then with the proper design of the apparatus here proposed and with the necessary precautions taken to arrange proper protective nets and other paraphernalia so that the "Aerial Passenger Rocket" cannot land so as to injure the passengers, it would seem quite possible with modern engineering technique, that the device would be practicable. It would not be surprising to us, if such a scheme as this should greet our eyes even within the course of another year or two at one of our great national playgrounds.

Articles to Appear in the January Issue

How Henri Becquerel Invented Radio-Activity—Special Feature Article. Written by Prof. Becquerel.

The Helicopter, An Accomplished Fact. By Robert G. Skerrett. The newest thing in vertically rising flying machines.

Electric Locomotives Cross Western Mountains. With special illustrations. By H. Winfield Secor.

Popular Explanation of the Einstein Theory. By Isabel M. Lewis, M.A., of the U. S. Naval Observatory.

Is There a Sub-Electron? By Rogers D. Rusk, M.A. An interesting and timely discussion.

The Giant 100-Inch Mount Wilson Reflecting Telescope. A brilliant discourse on large astronomical telescopes and their lenses. By Prof. Floyd L. Darrow.

The Capitol Theater of New York City and Its Electrical Stage Features. By Joseph H. Kraus.

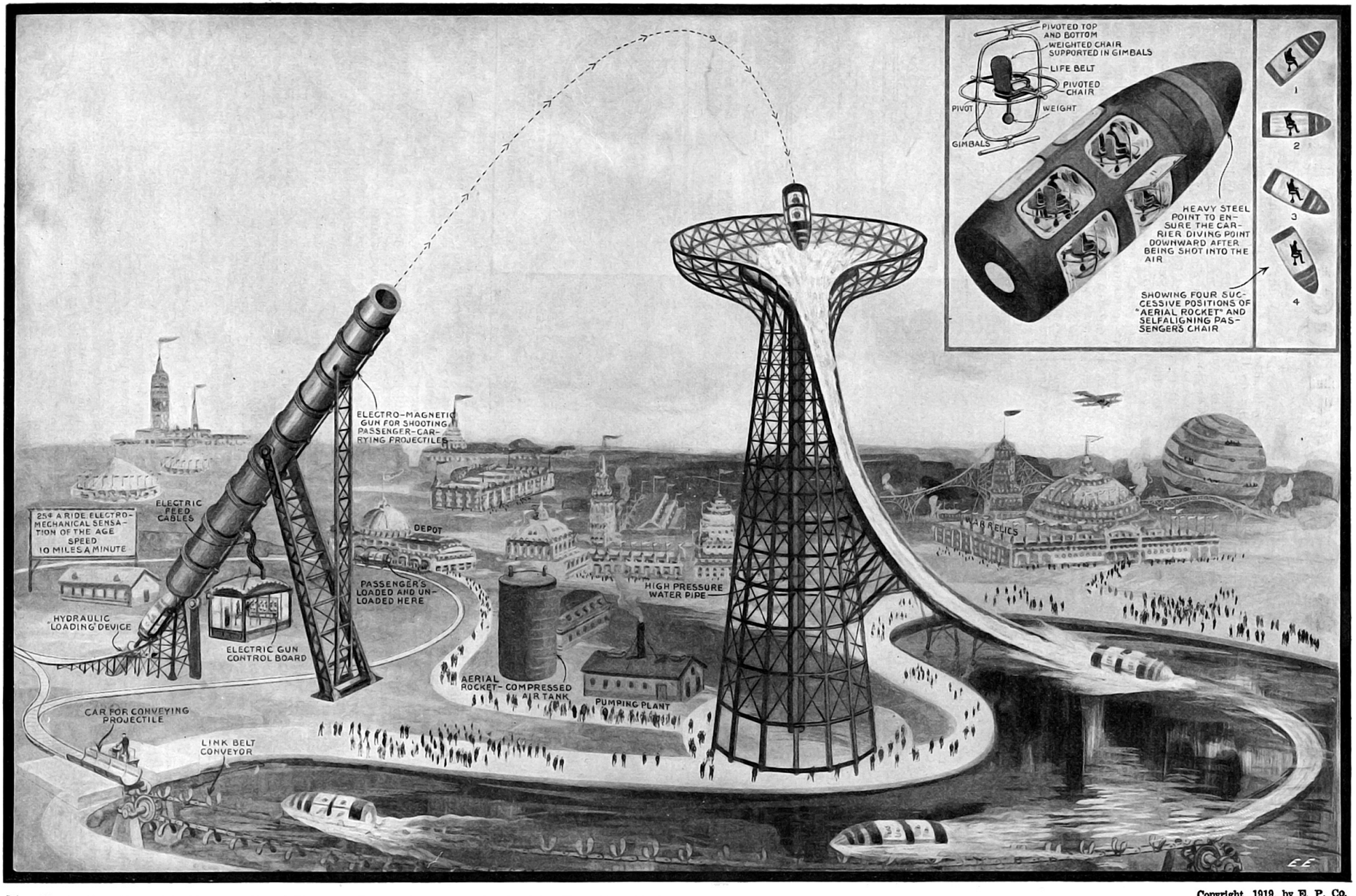
What Atomic Forces Could Do. A popular description of the tremendous energy locked up in the atom.

Exact Radio Direction Finding. With photos and diagrams. By A. E. Harper.

How the Electrical Engineer Works. Popular illustrated story of the daily work of the engineer.

Magnetic Storms. By Prof. Lindley Pyle.

Reversible Airplane Propellers and How They Work.



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The Illustration Herewith Shows a Novel Pleasure Resort Attraction Devised by Two New York Inventors. Altho, at a First Glance, It May Seem Impracticable to Construct Such a Daring Amusement Contrivance as This, a Little Reflection Will Show That It Is Not so Impossible at All. In the Circus We Are Used to Seeing a Person "Loop-the-Loop" or Turn a Somersault In Mid-Air While In an Automobile, the Vehicle and Its Passengers Landing Right Side Up on a Properly Inclined Platform, Down Which It Glides to Earth. Our Artillery Experts Can Compute with Extreme Accuracy the Trajectory of Various Projectiles, Both Large and Small, and Thus It Should Be Quite Possible, with the Aid of Modern Mechanical Engineering Technique, to Build One of These Aerial Passenger Rocket Amusements Successfully. The Gun Out of Which the Shell or Rocket, with Its Human Cargo Is Shot, May Be Operated by Compressed Air, by Powder, or It May Be an Electro-Magnetic Gun. After the Shell Has Sped Thru the Air, Over the Course Indicated by the Dotted Lines, It Lands on a Large Cushion of Water Emerging from the Stand Pipe Shown. It Proceeds to Glide Down to the Lagoon on a Cushion of Water Also, and Upon Striking the Lagoon, It Is Guided Back to the Starting Point by a Link-Belt as Here Illustrated. Electric Cars of Special Type, Seen at the Left of the Picture, Carry the "Rockets" Back to the Station, Thence Around to the Gun Breech, Where a Hydraulic Plunger Loads the Carrier Into the Gun.

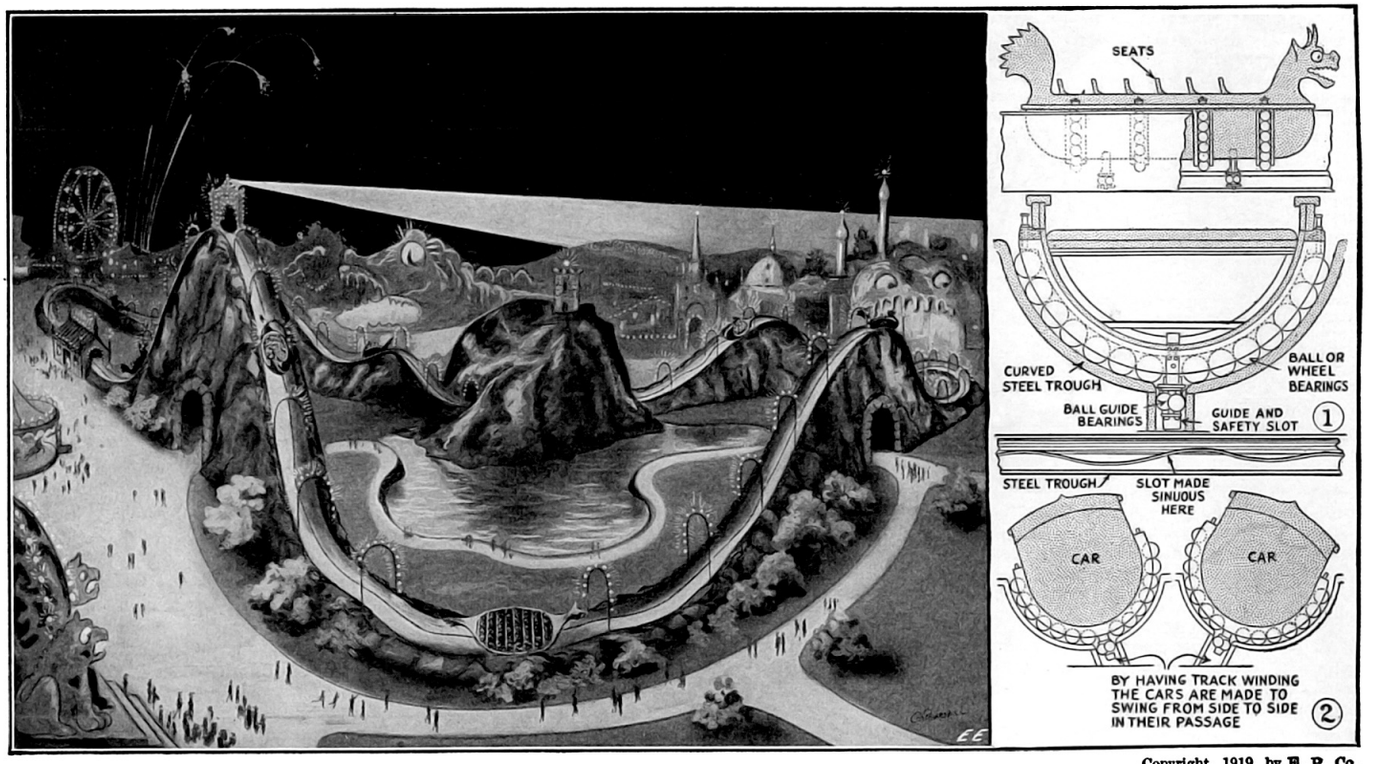
An Oscillating Scenic Railway

BY means of a sinuous undulating track on this new scenic raliway, the cars are caused to oscillate. Scenic railways are not new, by any means, but a radical departure in the design for an improved *Pleasure Railway,* as its inventor, Peter F. Meyer of Brooklyn, N. Y., calls it, is incorporated in the one here illustrated. Several novel and important features, both with regard to the amount of pleasure to be derived by the passengers on Mr. Meyer's pleasure railway, as well as with respect to their safety, have been worked out by the ingenious inventor.

One of the principal objects of Mr. Meyer's new design of scenic railway is the safety feature, and it is applied in a very simple manner. At the bottom of each passenger-carrying car there are two rigid vertical shafts, securely fastened to the base of the car, and suitable wheels are placed on these shafts in such a manner that they minimize any friction as the car rolls along, while at the same time preventing the car from jumping out of the rail slot, as becomes evident, as in order to do this the lower wheels on the vertical shafts would have to be wrenched off.

The inventor has provided an ingenious anti-friction scheme for supporting the cars in the hollow steel or wooden trough, along which the cars ride, and to this end he provides a series of round iron balls. These balls are held in grooves in such a manner that they cannot drop out, but they are held sufficiently loose so as to be easily rotated. The cars thus roll along on this series of balls in the same manner as a roller skate moves along with a minimum of friction on its ball bearings. Of course, where desired, and if the builders do not care to go to the expense of utilizing the ball bearings on the cars, wheels can be substituted, but these would have to be pivoted in two directions, preferably so as to obviate any undue noise or friction as the car sped along and suddenly changed to a tilting position, due to the grooves encountered in the guide rail or slot.

To begin with, the passenger-laden cars may be hauled to the top of the first highest incline by means of a link belt hoist or conveyor in the well-known manner. As the inventor mentions, the track over which the cars speed is best made continuous or endless; the cars to eventually finish a run in front of the station at which they started from. The track is made preferably of thin steel in a trough-like or semicircular form, and, as will be evident to the reader, the inventor has certainly shown original design, and also a very practical and feasible idea in bringing forward this new proposal for building scenic railways. If the people want something exciting and novel in this line, why not give them something that is really novel. For probably a generation now people have become accustomed to the old-fashioned, undulating, humpback scenic railway, but Mr. Meyer has, we think, given us something just as pleasing as its prototypes, and one which will bring in a new era for scenic railways. As you dash down one of the great inclines at mile-a-minute speed, you think you are safe and sound when you reach the bottom and have nothing to do until to-morrow, as the proverb goes, when suddenly—zowie!! the car careens sidewise, or slowly but surely takes an angular tilting position, the same as a small boat on the ocean. Of course you should not have a headache when you start on your journey over Mr. Meyer's oscillating scenic railways, but if you like good sport and feel right for the trip, you will wonder how it ever happened that the older type pleasure railways have existed so many years without a single change in their design or construction, excepting for the innovations now and then, with which we are more or less familiar perhaps, such as long dark tunnels (the longer the better some of us wish, what!!?? . . .), with a few "A Street in New York" hurdy-gurdy scenes, as well as Uncle Tom's "Little Eva" ascending to heaven, etc., ad lib. Possibly by next year they will degenerate to showing us scenes of the Bolsheviki regimé in darkest Russia, where you go down to the public "Spouse Market" and pick out your wife for the next six months.



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The Cars on This New Scenic Railway Sway Back and Forth Sidewise, Like a Boat on the Ocean, as They Shoot Along the Troughlike Tracks. The Cars Roll on Ball Bearings, as the Detail Drawings Show. This Pleasure Railway Provides a "Real Thriller" for the Amusement-Seeking Public.

Turf Fuel for Power

Electrification of Moscow factories on a basis of turf fuel is in progress under the direction of the engineering staff of the Soviet Government, according to Arthur Ransome to whom the scheme was explained by the President of the Supreme Council of Public Economy. ("Russia in 1919," Huebsch.)

"He said that there was no water power near Moscow but big turf deposits which would be used as fuel. In order not to interfere with the actual lighting of the town from the power-station already in existence, they are taking the electric plant from the Provodnik works, which will supply enough electricity for the lighting of the town. As soon as that is set up and working, they will use it for the immediate needs of Moscow, and set about transferring the existing power-station to the new situation near the turf beds. In this way they hope to carry out the change from coal to turf without interfering with the ordinary life of the town. Eventually when things settle down they will get a larger plant. . . .

"I asked how they were going to get the machines. He said that of course they would prefer to buy them abroad, but that, though this was impossible, the work would not be delayed on that account, since they could make a start with the machines they had."

Airplane Supercharger for High Flying

By CHARLES M. RIPLEY

IN 1783 Benjamin Franklin witnest a balloon ascension and after seeing it he wrote as follows: "A few months since, the idea of witches riding thru the air upon a broom-stick, and that of philosophers upon a bag of smoke, would have appeared equally impossible and ridiculous—these machines must always be subject to be driven by the wind. Perhaps mechanic art may find easy means to give them progressive motion in a calm, and to slant them a little in the wind."

Today our aviators laugh at a 60-mile gale—it is negligible compared with their own speed of 150 miles per hour. And 200 miles per hour and even more, is seen upon the horizon for regular commercial airplane service; for the new *Supercharger* or oxygen booster assures us that the long distance air transportation of the future will be conducted at from three to five miles up in the sky, where the air resistance is less than half that at sea level.

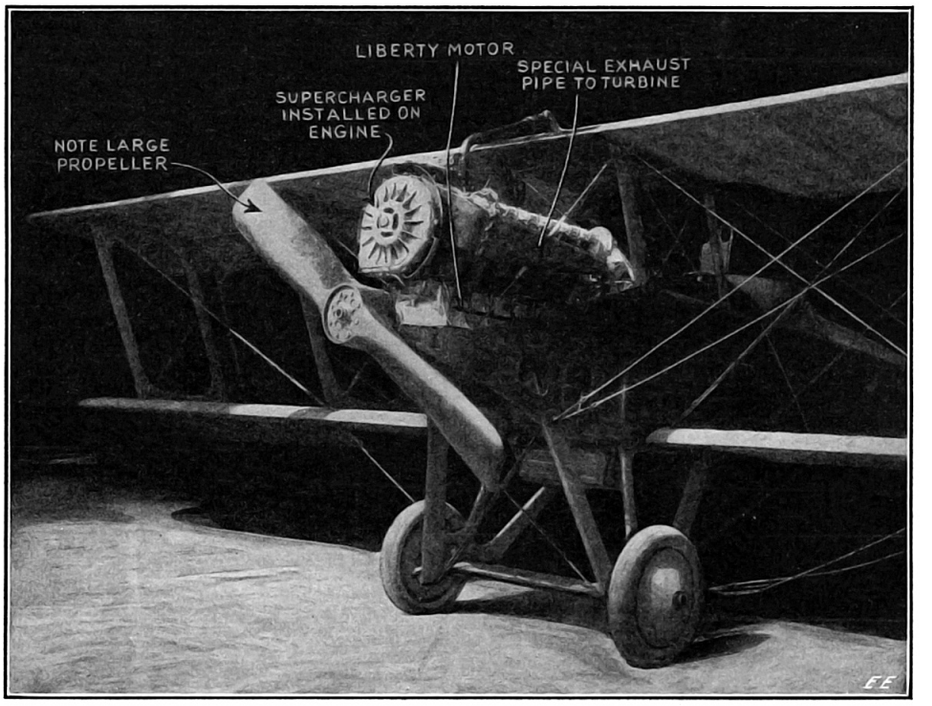
At Wilbur Wright Field, August 2nd, a U. S. Army aviator broke the world's speed record at high altitudes. Major R. W. Schroeder of the U. S. Air Service, while at an altitude of 18,400 feet, attained an official speed of 137 miles per hour.

The official report states that "he used a two-seated La Père biplane, built by the Packard Motor Car Co., and designed by Capt. La Père of the French Army, while in the employ of the U. S. Government. It had a 12-cylinder Liberty motor, equipt with a *supercharger* developed by Dr. S. A. Moss, a turbine research engineer of Lynn, Mass., working in cooperation with the engineers of the U. S. Air Service. So far as is known this is the highest speed ever attained at this altitude with a two-seated plane; and the best speed known for a single-seater at this altitude was only 128 miles per hour."

It is not generally known among "landlubbers" that heretofore every airplane engine lost 50% of its power when up 20,000 feet; and that at 25,000 feet its loss of power is between two-thirds and three-quarters—that is, instead of having 400 horsepower, as at sea level, it only has 100 to 150 horsepower.

So far as is known now, the *scarcity of oxygen* at the high elevations is the only factor which has made 30,000 feet "the Ceiling of the World." So the engine suffers from lack of oxygen, just as do the birdmen.

The thin "skin" of air which surrounds the earth is no thicker than the skin of an apple—relatively speaking. Thus it is that the daring birdmen who approach the ceiling of the world must prepare to take oxygen from a tank as they near 15,000 to 18,000 feet elevation. Otherwise they would suffocate.



La Pere Airplane That Broke World's Speed Record at 18,000 Feet Altitude. Liberty Motor Equipt With "Super-Charger" or Oxygen Booster, Which Is Shown at Front of Engine and Just Above the Propeller Shaft. This Small Attachment Practically Doubled the Horse-Power of the Engine at an Altitude of 18,400 Feet, Where the Air Is Extremely Rarefied and Deficient in Oxygen. In Future Flights It is Expected That Previous Speed and Altitude Records Will All be Eclipsed.

The *supercharger* used recently by Major Schroeder and his observer, Lieut. G. W. Elsey, is one of the most remarkable inventions which have been developed as a result of America's participation in the World War. The observations (officially checked) show that altho the plane was 18,400 feet above the ground, the air supplied to the carburetor had the same density as that at 2,900 feet elevation. Thus the supercharger gave the engine an amount of power equivalent to what it would have had, if it had been 16,500 feet nearer to the ground. So this attachment is as useful and necessary to the engine as is the tank which supplies oxygen to the sky-pilot.

The supercharger or oxygen booster is a little device only 19" in diameter, and complete with piping, adds only 100 pounds additional net weight to the plane; yet it practically doubled the power of the Liberty motor! Such vast quantities of oxygen are needed by the motor that it is impossible to carry a supply in tanks as is done for aviators, so the supercharger TAKES IT FROM THE AIR! Literally the wonderful little device compresses the rarefied air until it equals that near sea-level, and then this "good, thick sea-level air" is fed to the carburetor. It takes a considerable amount of energy to suck in air which is already at 50 per cent vacuum or more and compress it—or "buck the vacuum." But there is where the engineer has played a brilliant trick—for he has found some energy there, miles up in the sky, which he can use.

Where do you suppose the power comes from which doubles the power of the Liberty motor as it approaches the "ceiling of the world"? Why, from the red-hot exhaust gases of the Liberty motor! It is so simple: heat is energy; heat is thrown away in the exhaust gases; therefore the Yankee engineers set about to collect this power.

Now the gases exhaust into manifold or flat-shaped pipes (one on each side) which convey it to a gas turbine. The turbine is thus driven at 20,000 to 25,000 revolutions per minute—40 revolutions per second! Thus the wasted energy is now reclaimed into a useful by-product power; and this power drives the air compressor. The combination of the turbine and the centrifugal compressor is called a *supercharger*, and the weight is only 100 pounds!

Engineers—whether airmen or not—have shown intense interest in and admiration for this outfit. A "gas turbine" itself is a

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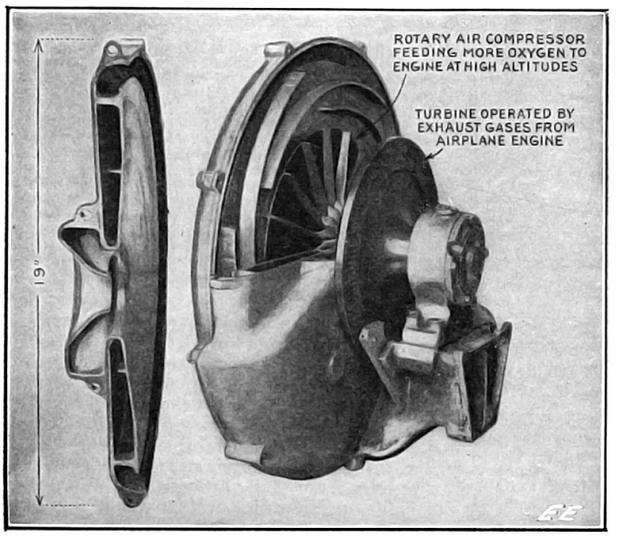
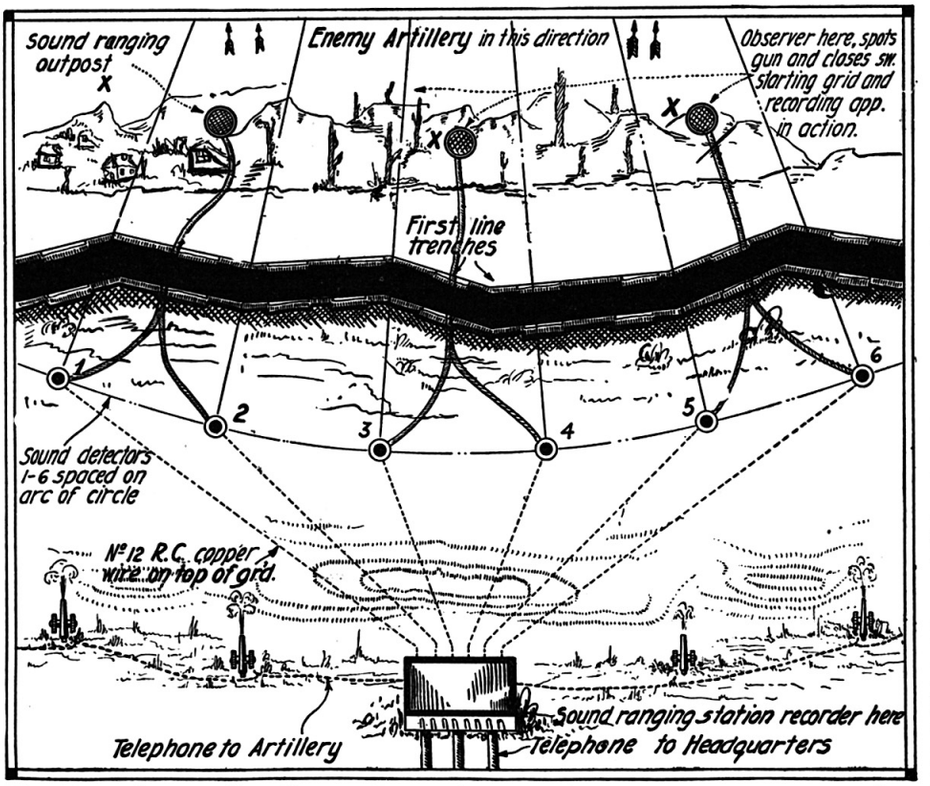


View to the Left Shows the Wonderful New Airplane "Super-charger" Which Pumps Increased Amounts of Oxygen Into the Gasoline Engine Carburetor System, When the Airplane Is Flying at High Altitudes. As Is Well-known, the Airplane Engine Loses About 50 Per Cent of Its Power at an Altitude of 20,000 Feet and to Overcome this Reduction in Speed and Climbing Power of the Plane, This Device Has Been Produced. A Turbine Drives the Rotary Air Compressor, the Turbine Being Operated by Exhaust Gases From the Airplane Engine.

Sound and Flash Ranging in the A.E.F.

By Prof. Augustus Trowbridge

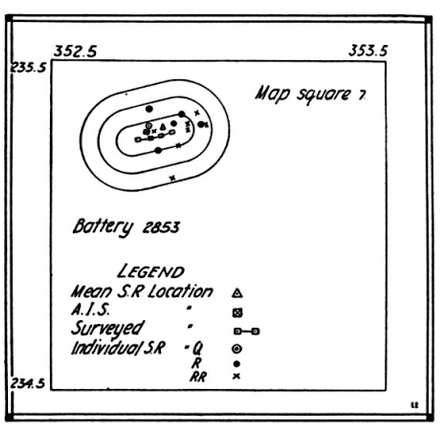
DEPARTMENT OF PHYSICS, PRINCETON UNIVERSITY. LATE LIEUTENANT-COLONEL, CORPS OF ENGINEERS, U. S. ARMY, IN TECHNICAL CHARGE OF THE SOUND AND FLASH RANGING SERVICE OF THE AMERICAN EXPEDITIONARY FORCE.



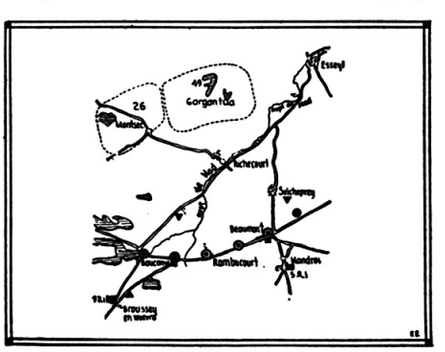
The Above Chart or Map Shows a Typical Layout of "Sound Ranging" Stations at the American battlefront in France, as Actually Used for Locating German Artillery. The Photographic Record of Enemy Gun Bursts Was Recorded at the Sound Ranging Headquarters Station, From Which Wires Radiated to the Various Listening Stations, Placed Along the Arc of a Circle at 1, 2, 3, 4, and So Forth. Every Enemy Gun Was Accurately Located, Numbered and Charted in This Way.

AFTER the first battle of the Marne in the early autumn of 1914 the war on the western front soon took on the character of a gigantic siege operation in which each belligerent played the parts both of besieged and besieger on different portions of the battle front. The long period of trench warfare set in during which each side increased the number, the caliber and the range of its artillery—the heavier calibers were most carefully concealed both through the choice of naturally favorable positions and through the use of the new practice of camouflage, so that the location of the enemy batteries by existing methods became increasingly difficult and often impossible.

The new problem, which the French were first to solve, was first, the location by some other means than sight of invisible enemy batteries and the directing of the fire of their own batteries on these and other enemy targets, and, second, the location of, and the *ranging* on, the enemy batteries which tho not completely hidden, were so distant that the ordinary triangulation methods from a short base-line hitherto practiced by the artillery were not sufficiently accurate to accomplish. To attain these two objects the French inaugurated two new services of artillery information which have been called respectively Sound Ranging and Flash Ranging.



This Map of Which Thousands Were Made Daily by the "A. E. F." Engineers on the Battlefront in France, Shows the Accuracy With Which Enemy Guns Were Located by Sound Ranging, S.R. by Artillery Information Service, A. I. S., Etc. Dots in Squares Show Actual Location of Guns.



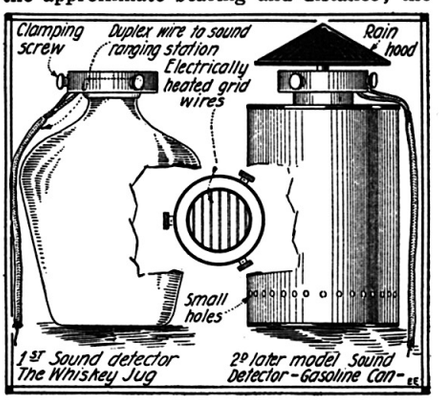
An Actual Map of Sound Ranging Stations in the Vicinity of Seicheprey, France. Sound Ranging Central Station at S.R. 1. Observing Instruments Indicated by Black Dots in Circles. Flash Ranging Stations F.R. 1. Enemy Artillery Located in Areas Enclosed by Dotted Lines.

These services were copied by the British with but slight modification as regards organization and later by the United States, which organized both services under one head.

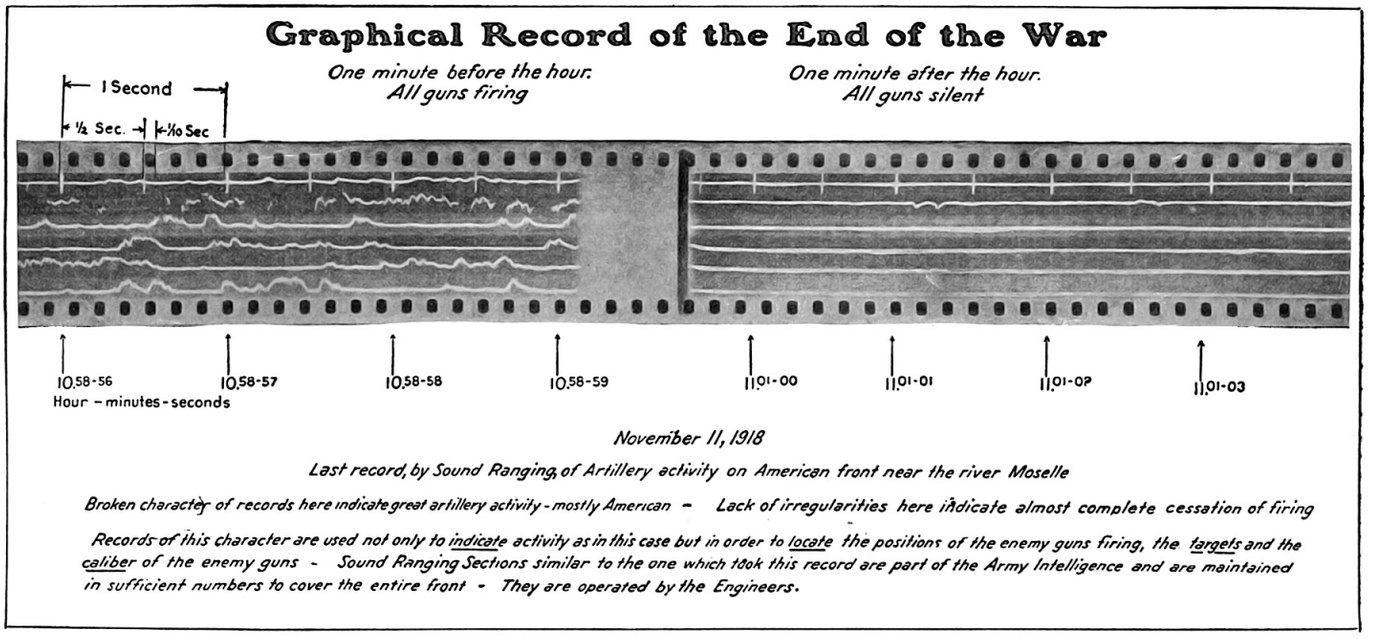
The flash ranging services in all of the allied armies were very similar both as regards instruments and methods of observation and report; such differences as there were were due chiefly to the methods of training and to the character of the personnel. The Germans also had an extremely efficient flash ranging service, many of the good features of which were copied by the Allies as they became known through prisoners and captured documents.

A flash ranging section consisted of about 100 men under the command of a lieutenant, who was assisted by three other officers. The installation consisted of a central calculating station—marked F. R. 1.—and from four to six advance observation posts—marked as erect triangles on the accompanying map, which gives approximately the positions occupied by one flash and one sound ranging section on a ten kilometer front in the spring of 1918.

At each observation post two men were on duty at all times, day and night, and each post was in telephonic communication with the calculating station and with each of the other posts of the section. Each post was provided with suitable day and night telescopes mounted on graduated circles for measuring the bearing of a sight away from the north-south line. The method of operation was as follows: If an observer at one of the posts noted the flash of an enemy gun, or even only the smoke puff he called back to "central" the approximate bearing and distance; the calculating officer at central was provided with a large plotting board, on which the surveyed positions of all of the observation posts were accurately marked and which was provided with weighted strings and angular scales for each of the posts. When a report came from an observation post the calculator at the plotting board set the corresponding string in the direction reported and brought all the other strings to cross the first at about the estimated distance and called to all the other

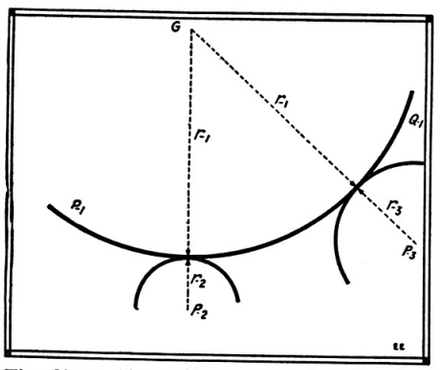


No Microphones of the Usual Carbon Grain Type or Anything Like Them Were Used in Picking Up the Sound of the Enemy Guns in the "A. E. F." Sound Ranging Work. What Was Used, However, Was a Fine Grid of Electrically Heated Wires Placed Over the Mouth of a Whiskey Jug, at First and Later Over the Mouth of a Discarded Gasoline Can, Which Latter Acted as Sound Resonating Chambers. When a Sound Wave From an Enemy Gun Several Miles Distant, Perhaps, Which of Course Was an Air-Wave, Impinged Against the Heated Wire Grid, It Caused a Variation in Temperature of the Grid, and in Turn a Variation of Its Electrical Resistance.



One of the Most Remarkable Graphical Records Extant Delineating the End of the Great "World War." This Is a Reproduction of a Sound Ranging Record Taken at the American Front at 11 O'Clock on the Morning of November 11, 1918. Note That the Gun-fire Was Very Active up Until the Last Minute Before 11 O'Clock; While at One Minute Past 11, the Firing Practically Ceased. Two Gun-bursts Appear on the right of the Chart at 11.01-01 and 11.01-025, Which Show Where a Boche Had Let Go a Few Seconds After the 11 O'clock Period When the Armistice Called for Firing to Cease.

posts to set their instruments in the proper direction as given on the board. After one or two more rounds by the enemy gun, several or all of the posts might be in a position to give an accurate report of the direction as seen from these posts, and the calculating officer be enabled to obtain an accurate intersection of the strings on the board and thus be able to report to the artillery the location of the gun which had been firing. In case of great enemy artillery activity when there was danger that all the posts might not be sighting on the same enemy gun, an electrical synchronizing device was employed which enabled the calculating officer to assure himself



The Chart Above Shows How the Sound of a Gun Fired at "G", Requires Different Lengths of Time to Travel to Various Locations and How the exact Position of the Gun may Be Surveyed by Sound When Several Listening Stations Located at Say P1, P2, P3, etc., are Employed in Determining the Exact Arrival Time of the Sound From the Gun at Each of These Points.

that all the observations were made at the same instant. This rendered it unlikely that different observers should report on different guns firing at about the same time.

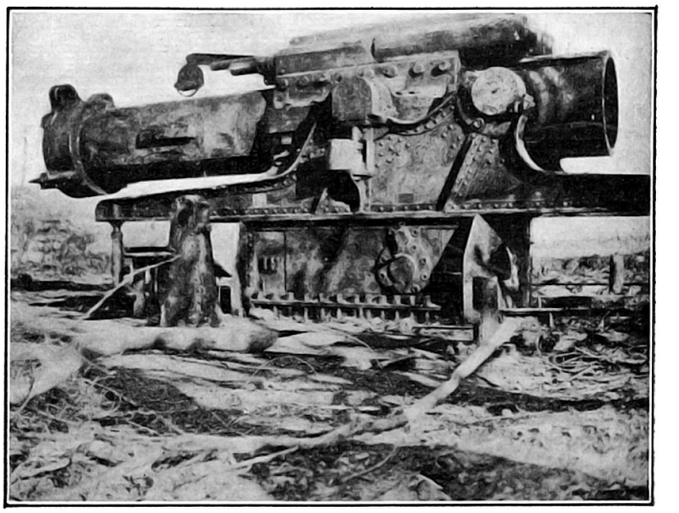
In directing the fire of the friendly artillery the procedure was similar with this difference that it was the *burst* of our own shells on the ground in the case of ranging on a visible target that was observed and plotted or the burst in the air in the case of an invisible target. In this latter case known corrections could be worked out to permit of a burst at or near the invisible target.

A sound ranging section was similar in organization to the flash section except that there were fewer men (60-70), due to the fact that instruments took the place of living observers to a great extent. The "central" instrument recorded photographically the time of arrival of the sound of the enemy guns at a series of instruments at surveyed positions near the front line and covering a length of about five miles; this instrument delivered automatically, developed and fixed photographic records in less than a minute after the sound of the enemy gun reached the front line and this record could be interpreted by the use of quick graphical methods so that the position of the gun could be telephoned to the friendly artillery in about a minute more. The probable accuracy of the location could be estimated and also the caliber and target of the gun which had just fired; this and the fact that neither rain, fog or darkness interfered with sound ranging were unique and valuable features of the service. Calculations were rendered difficult by great artillery activity tho they were not impossible except under actual barrage conditions.

On the accompanying map the sound ranging central is marked S. R. 1, and the observing instruments are shown as circles lying equi-spaced along a circular arc, whose center lies near the groups of enemy artillery shown enclosed in the two irregular areas, one of which was supposed to contain 26 and the other 49 active enemy batteries. The front line trenches ran about midway between these areas and the sound ranging instruments. In or near the trenches were two forward observation posts marked on the map as inverted triangles; at these posts observers were stationed, whose duty it was to start and stop by means of electrical relays the photographic mechanism at the central station whenever they heard the report of enemy guns whose positions it was desired to locate.

(*Continued on page* 832)

Stranger Than Any Fiction, Would Be the Tale That the "Sound Ranging" Experts of the "A.E.F." Could Tell You If They Wanted to, Regarding the Wonderful Hits They Made By Artillery. The Accompanying View Shows a Typical Hit on a Large German Howitzer Several Miles Behind the Lines, From an American Gun. This Shot Having Been Fired From Information Gained by the Sound Ranging Corps. The Enemy Gun Was Put Out of Commission, the Recoil Cylinders Having Been Blown Off and Totally Disabling It. In One Case, a Railroad Train Was Fired at Several Miles Behind the Lines the Train Being Completely Wrecked on the Bridge It Was Crossing at the Time, Due to Shell-fire. Not Only This, But the Location of Friendly Shell-bursts Could be Checked Up and Measured by the Sound Ranging Experts and the Gunners Told in a Fraction of a Minute, to Alter Their Range to the Right or to the Left, Until the Shell Landed Squarely on the Target.



Rohlfs Flies 34,610 Ft.—New World's Record

FLYING his Curtiss "Wasp" type triplane, with a 12-cylinder, 400-horsepower Curtiss motor, Roland Rohlfs, test pilot for the Curtiss Company, broke the world's altitude record, when, at Roosevelt Field September 18th, he reached the height of 34,610 feet, or more than six and one-half miles above sea level. On Saturday the 13th he had come within nearly 400 feet of this mark, but the flight was not official.

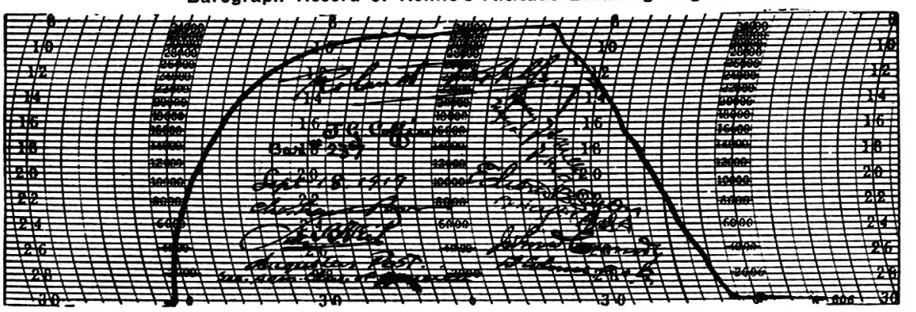
The previous unofficial record was 33,137 feet, made last May at Villa Coublay, France, by Adjutant Casale of the French Army.

Every precaution was taken therefore to make sure that all official requirements for a record were observed. A committee representing the Aero Club of America, composed of Augustus Post, Secretary of the club; Sydney B. Veit, and Professor C. L. Poore, Professor of Celestial Mechanics at Columbia University, were present. The army was unofficially represented by Colonel John D. Carmody, in command at Roosevelt Field; Major E. B. Lyons, in charge of flying at Mitchel Field, and Major Henry F. Miller.

Rohlfs left the ground at 12:06 o'clock and landed within twenty feet of his takeoff at 1:59.

© International Film Service

Roland Rohlfs, Who Broke the World's Altitude Record. He Is the Test Pilot for the Curtiss Engineering Corporation, and Is Shown Seated in His Curtiss "Wasp" Machine Before the Start of the Flight Over Roosevelt Field, Mineola. He Ascended to a Height of 34,610 Feet, Establishing a New World's Record. The Inset Photograph Shows Rohlfs Rising From the Ground for His Record-Breaking Flight. The Chart Below Is a Copy of the Official Barograph Record of Rohlfs's Altitude-Breaking Flight.



As he landed he stept out and handed the sealed barograph to Mr. Post. When the latter called out that the instrument showed a new world's record the onlookers cheered. The barograph was then resealed by the Aero Club committee. It was shipt to Washington where it will be calibrated by the Bureau of Standards and subjected to the most detailed and exhaustive analysis and testing. Until the result of this examination is given out, the reading will not be recorded by the Aero Club as absolutely official.

Rohlfs wore a suit of fur-lined clothing, and heavy felt mittens made by himself from material half an inch thick. Of the flight, he said:

"At 20,000 feet, trouble began. I had to call on my oxygen bottle. This feeds air to my lungs thru a device something like a football nose guard. At first I tried drawing it in thru the nose and mouth, but this dried my throat and I had to shut my mouth and breathe thru the nose alone. If anything had happened to this oxygen apparatus I would have been a 'goner.'

"At 31,000 feet the plane began to wobble in a way that, frankly, frightened me. It careened this way and that, and while doing so dropt 600 feet. I threw on more power and up it went again." (The barograph markings showed the fall plainly.)

"When I reached the 'peak' the thermometer showed forty-three degrees *below* zero. It took seventy-eight minutes to get this high and I spent another twenty minutes trying to make the plane rise still higher. I used every trick I knew, but could not coax another foot of altitude out of it. I believe I attained the absolute top possible in this machine.

"I noticed several peculiar things up there. Near the top I felt nervous twitchings in parts of my body. These were at several scars left by an automobile accident several years ago. After my two other high flights my teeth ached severely and also my stomach. I guess I can count on the aches lasting about ten days more. They lasted that long when I went above 30,000 feet before."

Rohlfs reached 10,000 feet in eight minutes after leaving the ground. He flew as far as Riverhead, L. I., where a head wind made him turn about. When at the highest altitude he was above Lake Ronkonkoma, which is twenty-five miles from Roosevelt Field.

Rohlfs made his flight after most careful study of his problem, paying particular attention to how much weight he could spare from his machine with safety. Rohlfs contemplated removing the tires but changed his mind and left them on. By a judicious casting off of nuts, bolts, wires, and fire-fighting apparatus and lessening his gasoline supply to eleven gallons he reduced the weight of the machine by 100 pounds.

New World's Record for Pilot and Passenger.

A new official world's altitude record for pilot and one passenger was made at Dayton, Ohio, on September 6, when Major Rudolph W. Schroeder climbed to 28,500 feet in a Lepere biplane equipt with a 400 horse power Liberty motor, according to announcement made recently by the Contest Committee of the American Flying Club, which had charge of the recent New York-Toronto contest. The announcement followed the homologation of data and barograph charts sent by Colonel Thurman H. Bane, Chief of the Army Airplane Engineering Division at McCook Field, Dayton.

This new mark of 28,500 feet greatly surpasses the former two-man altitude record held by Captain Lang of the Royal Air Force, who ascended to 27,300 feet on January 2, 1919, in a 375 horse power English biplane. No official figures have been received in this country yet in regard to the reported altitude climb of Adjutant Casale, who, with one passenger, according to unofficial reports, broke previous records last June. Until official proof of this flight is received by the Contest Committee of the American Flying Club, Major Schroeder's record will stand as the world's record for pilot and passenger.

Major Schroeder's new record is of international interest because it was made possible by the new airplane engine *supercharger* originated during the war but

(Continued on page 826)

New York Electrical Show

THE annual Electrical Exposition held in New York was more resplendent than ever before, this year. It was discontinued during the war and, judging by the size of the crowds that visited the exposition this year, the public was pleased indeed to see once more on exhibit the latest advances in electrical wizardry. The exposition at New York was staged in the Grand Central Palace, a very handsome building and one that provided a commodious space for the beautiful display of the various apparata, instruments and devices, which included everything imaginable from a specially sensitive micro-ampere meter, the needle of which indicated in millionths of an ampere, the current produced by applying your dampened finger to an iron nail and a one-cent piece—up to a ponderous electrical storage battery truck, or a complete electrical dairy, where the electrically operated vacuum milker was demonstrated several times each day.

The accompanying illustration shows just a few samples of the hundreds of electrical devices exhibited and which appealed to every member of the family, from little Tommy Edison, Jr., up to old Grandad puffing contentedly on his old and tried "Meerschaum." What, between electrical washing machines that wabbled around, or back and forth, including some that oscillated up and down, with electric lights shining thru their soapy depths, electrical sirens and powerful X-ray machines, together with wireless sparks and a few dozen other choice crashes and flashes thrown in for good measure, the electrically interested populace was thoroly entertained. Excellent band music was furnished afternoons and evenings during the week of the exposition.

At the New York Electrical Show, Which the Editors Visited, There Were Several Ingenious and More or Less Practical Electric Apparata Exhibited and Demonstrated. A Few of the More Interesting and Useful Things That We Noted There, Are Illustrated and Described Herewith, for the Benefit of Readers Who May Not Have Had the Opportunity of Witnessing This Wonderful and Educational Electrical Display.

WHAT WE SAW AT THE SHOW

A very clever vase light was demonstrated and what "got our goat" was why—out of 100,000,000 people in Ameriea—some one had not thought of it before. It instantly converts any vase, no matter how big or small, into a beautiful electric lamp with a silk shade costing as much as you have money to buy yards of silk for. See Figure 1. As we walked down the aisle, our attention was arrested by one of the most efficient looking electric dish washers that we have seen for some time. The hot soapy water was forced up thru and around the dishes in great fashion, and if any microbes or bacteria could lift one of their hind legs after passing thru this scalding ordeal, well, they have got to show us, that's all! We told mother and the girls about it as soon as we arrived home, and as soon as the mail order houses start selling these electric dish washers on the installment plan, I and Mike McStinchy, the chief clerk at the office, have promised ourselves one apiece. Take a shot at Figure 2.

As we hove to, around the corner on one of the floors, we were almost "flabbergasted" trying to count the total number of electric vacuum cleaners exhibited. There must 'a been a million of 'em! One particularly large and interesting machine was being pushed slowly over a large Persian rug by a dusky demonstrator. "Some vacuum cleaner," quoth we. Egad, we had the wrong family this time! This machine (see Fig. 3) was an *electric rug and carpet washer*. When we got close up to it we saw that it had a rapidly oscillating scrub-

(*Continued on page* 815)

"Speaking Crystals"

By A. McL. NICOLSON*

MANY new and surprising things have come to light during the war. While the guns thundered in Europe, American scientists quietly went about their work, hatching out many new marvels.

One of the most unique inventions—at least from the Experimenter's standpoint—is the wonderful Piezo-electric effect of Rochelle crystals. In these, a veritable new gold mine has been opened to all experimenters. What these crystals will all do fairly staggers one's imagination. Think of a simple salt crystal that will actually talk, that can be a telephone receiver, and a transmitter combined, that will give as much as 100 volts when squeezed with two fingers, that will "sing" when current is supplied to it! And the best part is every one of us can make his own crystals and perform these experiments without having to buy this 20th century electrical wonder—for as yet it can't be bought, anyway!

We consider ourselves fortunate to present our readers with a very comprehensive article on the new invention by its inventor, Mr. A. McL. Nicolson. Many new uses will be found for the invention and we invite our readers to send us their experience for the benefit of all.—The Editors.

ELECTRICITY is liberated in many apparently different ways. There are at least a dozen so-called "sources" of electricity which are mentioned in text books. It probably could be shown that in every case in which electricity is produced, the fundamental cause of the manifestation is the same. We have merely different ways of operating on matter with the dissipation of some form of energy; and the electric charge or current is generated. This signifies the transformation of one form of energy into another, and, generally, the mechanism is reversible. For example, in the case of static electricity the influence machine may be used reversibly as a "converter" of electricity or of mechanical energy,—that is to say as a generator or as a motor. When we hear of a "new" source of electricity we are curious to find out all about the mechanism of the source—as to its reversibility, efficiency of energy conversion, applicability to the mechanical arts, etc.

"Piezo-Electricity", discovered by J. and P. Curie, is the name given, in 1881, to a crystal source of electricity. In this case electric charges of different signs are liberated on different surfaces of a crystal when mechanical stresses or vibrations are impressed on certain of its parts. The word *piezo,* pronounced p ī é z o, is derived from the Greek *piezein,* signifying "to press"; hence "pressure" electricity.

Crystals Which Evolve Electricity.

Not every crystal is *piezo-electrically* active. Nature grows crystals, whether mineral or organic, in thirty-two differing classes of structure—of these, just twenty classes offer the necessary condition for piezo-electric activity. And this condition is *asymmetry* of structure or of molecular arrangement. While a very large number of crystals have the electric property, only comparatively few exhibit the phenomenon to a sufficiently interesting degree to warrant mention of it at this time.

Amongst mineral crystals quartz and tourmaline are the best known having the asymmetric structure — the molecules consisting of regular "bricks", are staggered into a *skew symmetry* or *spiral structure.* In the case of the organic crystals, the molecules themselves are asymmetric, that is to say, they do not comprise "regular bricks". They have, in fact, little skew symmetries of their own. Both the mineral and the organic crystal exhibit their respective asymmetries as right- or left-handed skew structures. This is revealed in their power to rotate the plane of polarization of polarized light in corresponding right or left directions.

We are, just now, more interested in the *organic* crystal since this type, comprising, as it does, the asymmetric carbon molecule, has proved to be more susceptible of large piezo-electric effect. Examples of active organic crystals are sugar, camphor, tartaric acid, etc.

Rochelle Salt Crystal Very Active Electrically.

A crystal which is very active piezo-electrically is *"dextro rotary" sodium potassium tartarate or Rochelle salt.*

Recently, the Research Laboratory of the American Telephone and Telegraph and the Western Electric Companies investigated the possibility of developing piezo-electric crystals. It was soon found that crystals of *Rochelle salt* would give good results *if prepared in a special manner.*

Briefly, increased efficiency is brought about by the following conditions:

1. Selection of particular habit of growth.
2. Desiccation. (Preserving by exhausting the moisture.)
3. Development of the crystal into a composite polar structure.
4. Application of static compression.
5. Use of electric poles normal to each other.
6. Application of torque.

How the Crystals are "Grown".

Rochelle salt crystals are grown from nuclei or "seeds" of definite form. These are obtained by selection from crystal croppings spontaneously grown in a *supersaturated solution* of the salt (the formula is $Na\ K\ C_4\ H_4\ O_6.\ 4H_2\ O$). The solution should be made up of 8 parts Rochelle salts to 5.33 parts of water. The density of the solution at 50°C. is 1.33 and the nuclei from which large crystals are grown, are "planted" in the mother liquor when the temperature has dropped to 38°C. *The crystal grows rapidly as the temperature of the liquor falls to that of its surroundings.* The seeds are selected so that they are practically square shaped—the seed, for this purpose, must lie with its principal or optic axis in a horizontal plane.

When a crystal is grown very rapidly—as by the temperature gradient method described—it develops a *composite* structure termed by mineralogists the "hour-glass". Fig. 1 illustrates the entire process graphically.

How the Crystals are Mounted

Important use is made of this structure and its development is fully encouraged. It is found that if the crystal, when grown to the desired size, from 30 to 200 grams, and when thoroly desiccated, or dried, develops new and stronger electric poles on its surface. The vertical walls, surrounding the principal axis, *form one pole* while the *two horizontal,* or basal planes.

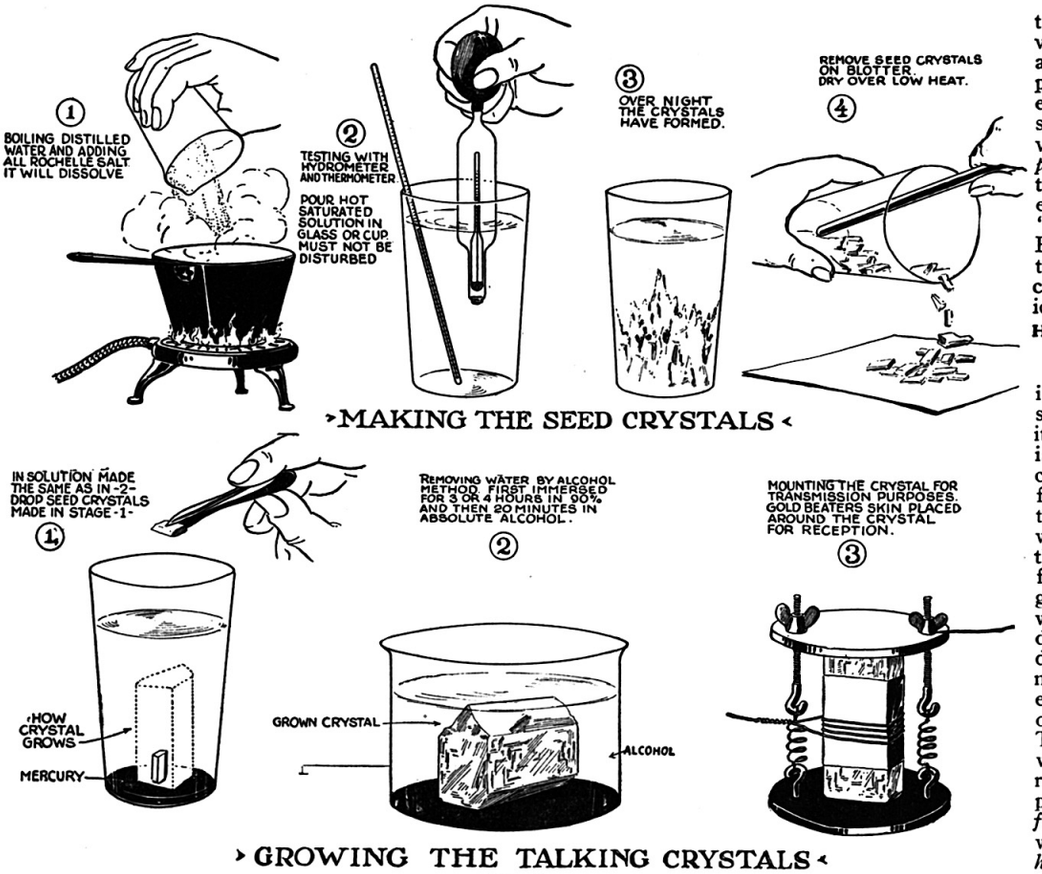
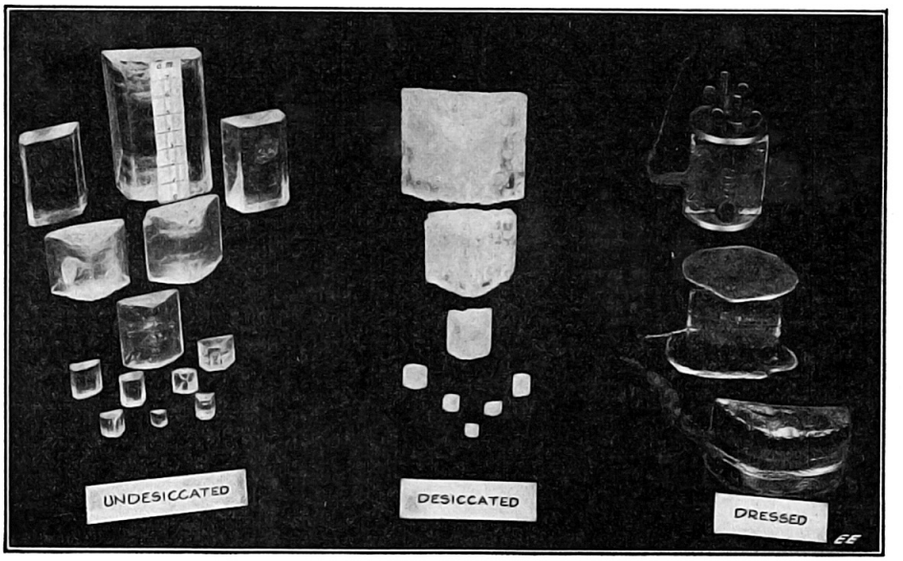
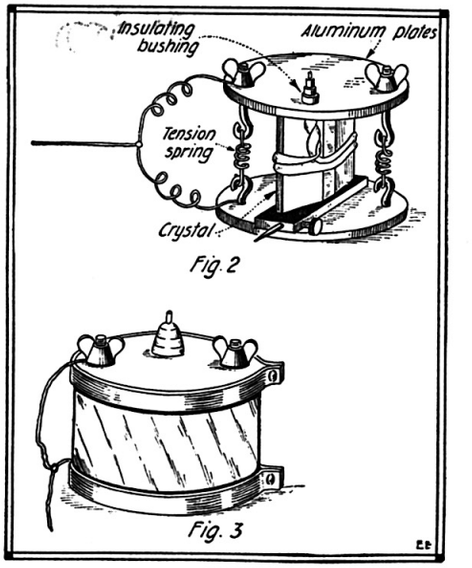


Fig. 1.

*Research Laboratories of the American Telephone and Telegraph Company and the Western Electric Company, Inc.



Appearance of Rochelle Salt Crystals Made By the Author,—Undesiccated; Desiccated and Finally Dressed, Ready for Mounting in Clamp.



Above:—Crystal as a Phonograph Transmitter. Below:—As a Transmitter or Receiver.

together *form the other pole.* Beeswaxed tinfoils serve as electrodes when applied to the crystal. Since compression greatly improves the piezo-electric effect in these crystals an appliance shown in Fig. 3 called the "spring compressor" may be used. The appliance comprises a pair of aluminium plates connected together with powerful springs. Thumb-screws are provided so as to apply 20 to 40 pounds pressure to the crystal. The compressor forms one pole, preferably the "grounded" pole of the crystal. The other is called the "girdle" pole, because fine wires may be stranded and wrapped around the crystal at its equator, making proper connection with the tinfoil coating there.

The mechanically sensitive regions of the crystal are at the four corners of the "square"—on the ends of the two basal planes. Care should therefore be taken to have the crystal *bear on these corners* in the spring compressors. This is readily accomplished by filing the crystal on its basal planes so as to render it slightly concave on both crystallographic poles.

An ordinary half round file is used, and the top and bottom faces filed in such a manner that the corners are elevated slightly; making them higher than the rest of the face.

When *compression* is applied to the crystal an electric charge is imparted to its poles—so that the *girdle* electrode becomes plus and the basal planes, together (or the spring compressors) become minus. This electrification will leak away and when the compression is relaxed, the *crystal poles will reverse* the signs of the liberated charges. Great sensitiveness is also obtained if the crystal is subjected to torsion. *A charge of several micro-coulombs and potentials exceeding* 100 *volts may be obtained by twisting the crystal with the fingers.*

The Crystals "Talk".

If, now, we reverse the process and apply electric potentials to the crystal poles, *sounds will be emitted by the crystal due to its relative displacement.* It will be found, if a small mirror be applied with wax to different parts of a crystal and its motions examined by projecting a beam of light reflected by the mirror to a screen, that the principal component of motion is one of *twisting.* The crystal thus "wriggles" under electric stress and *will emit tones in consonance with the potentials applied.*

Several interesting experiments have been performed utilizing one or other or both of the electrical and mechanical effects produced by the piezo-electric crystal. We may first use the crystal as a transmitter or detector of mechanical vibrations or sound. A very convenient application is to the phonograph. A needle may be inserted in a plate attached to one end of the crystal, fig. 2, so that, if held properly over a moving record the needle will transfer torsional movements to the crystal, and corresponding electrical currents will be generated. The alternating potential generated by the crystal under these circumstances may be as large as 10 volts and the resulting current will be several microamperes. In the simplest form of this experiment, electromagnetic receivers of high impedance may be used to detect speech and music from the phonograph. Since the impedance of the crystal at acoustic frequency is about 300,000 ohms, the impedance of the receivers used should be very high—*at least a few thousand ohms.* The crystal itself can operate *several hundred receivers* in series and parallel. See Fig. 4.

Instead of using the phonograph to agitate the crystal transmitter, we can, by adding a diaphragm to the crystal, talk or sing against the diaphragm and thus excite the crystal to about the same degree that obtains with the phonograph record. Thus by singing against the diaphragm near a resonant frequency of the crystal housing, say at a frequency corresponding to "middle C" in music, or 256 cycles per second, *we can generate an alternating current* in the crystal of 20 microamperes and an open-circuit potential of 15 volts. The former may be

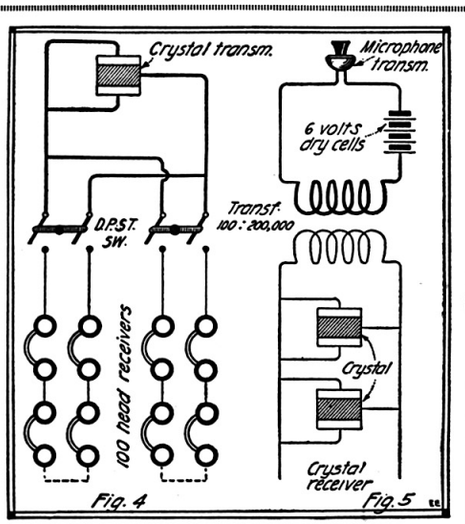


Fig. 4.—Circuit for Connecting Up 100 Telephone Receivers to Rochelle Salt Crystal Transmitter. Fig. 5.—Circuit for Crystal Telephonic Loud-Speaker. Photo at Right Shows Several Varieties of Rochelle Crystals.

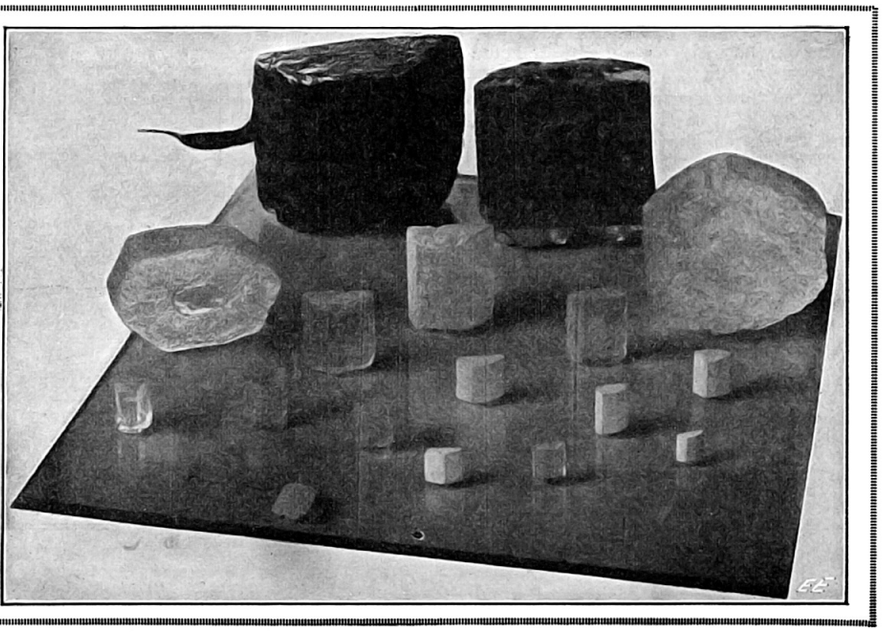
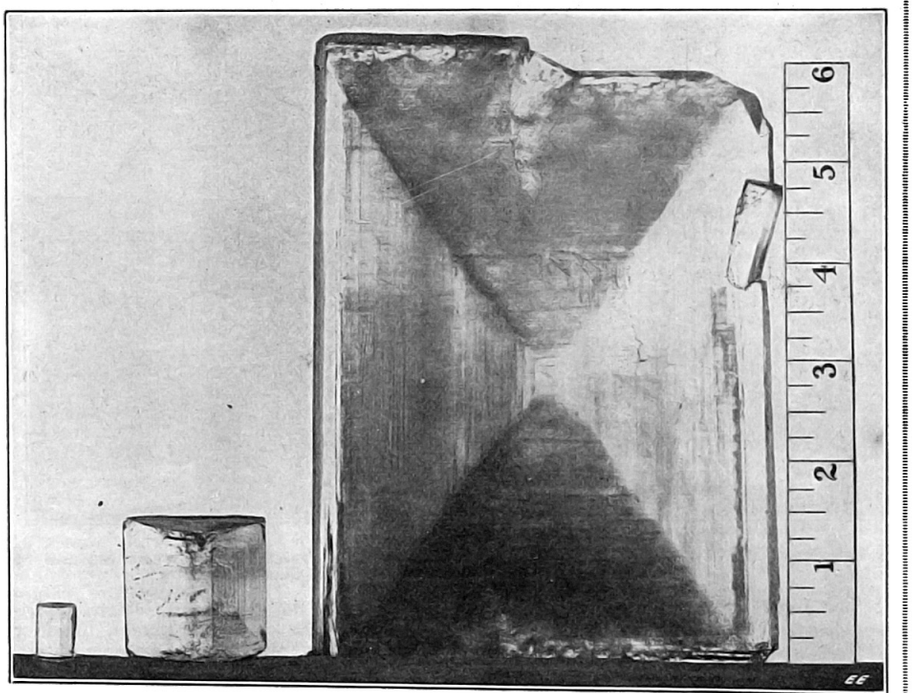


Fig. 3-A. How the Dressed and Mounted Rochelle Crystal Appears. The Diaphragm Is of Paper or Goldbeater's Skin Stretched Around the Outside as Shown.



Some Excellent Rochelle Salt Crystals "Grown" by the Author from "Seed Crystals." Some of These Crystals Have Been "Grown" as Large as Two feet and More. The Editors Have "Grown" Some Crystals Several Inches in Length Very Successfully, Following the Author's Instructions.

measured with a transformer, thermocouple and D. C. microampere meter, the latter with an electrostatic voltmeter.

The diaphragm used is rather novel. A strip of gold-beater's skin or even of paper (stiff bond) is wrapped around the spring compressors, holding the crystal, as in the first experiment, and metal bands tighten the strip on each of the two spring compressors. We now have a cylindrical diaphragm surrounding but not touching the crystal—yet conveying stresses to the crystal thru the spring compressors. The diaphragm, in order to be effective, must be corrugated as shown in Figs. 3 and 3A. This is done very readily by twisting the bands holding the diaphragm in opposing senses prior to its stretching and tightening. Usually a separate and removable appliance is used to perform these operations on the diaphragm.

Vibrations, due to sound waves, proceed from the cylindrical diaphragm thru the spring compressors, to the enclosed crystal. The crystal, when it is disturbed by the vibrations, converts these mechanical effects into corresponding electrical charges or currents, which may readily be detected in the receivers placed in the circuit.

Crystal Transforms Electricity into Speech.

But, as shown above, another interesting function of the crystal is that of a *receiver of electrical oscillations.* If we impress an alternating potential on the crystal poles and use the transmitter construction just described, then the crystal, itself vibrating under the electric stresses applied, will impart axial and torsional vibrations to the cylindrical diaphragm. Thus, corresponding acoustic effects will be produced which *may be heard considerable distances away from the crystal receiver.*

This experiment, using the crystal as a receiver, may be performed in different ways. Most simply, a carbon microphone may be applied as transmitter. This is shown in Fig. 5 with a local battery and high ratio transformer, which matches fairly well the low impedance of the local microphone circuit with that of the high impedance crystal. In this arrangement *the crystal operates as a "loud speaking" telephone* and may be heard several hundred feet away.

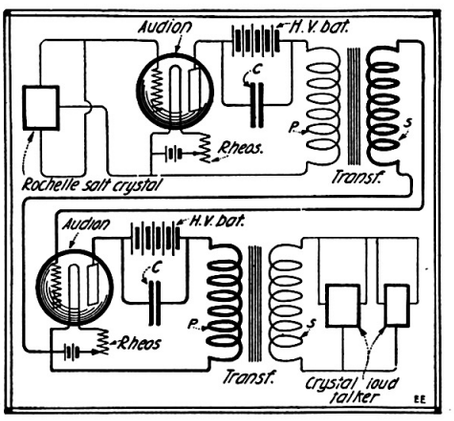


Fig. 6. Circuits for Connecting Speaking Crystal, Vacuum Tube Amplifier and a Second Crystal as a "Loud-Talker."

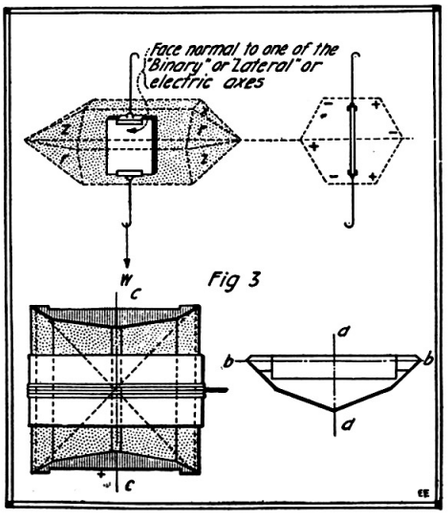


Fig. 7. Above:—Stress Applied to Quartz Crystal at "W" Produces Electric Current of Polarity Indicated. Rochelle Salt Crystals Act Similarly. Below:—Dressing of Crystals for the Girdle Orientation.

Another experiment is the use of crystals at both ends of a line. In order to increase the detecting and emitting effects of the piezo-electric crystal, the vacuum tube amplifier may be used. Fig. 6 shows a crystal transmitter, a crystal receiver, and an intervening two-stage vacuum tube repeater or relay. Speech and phonograph effects applied to the transmitter may be heard proceeding from the crystal receiver, with sufficient volume to fill a large auditorium. Under these conditions, if the crystal receiver is placed nearer than a few yards from the crystal transmitter, the receiver will *sing* to the transmitter. This well-known phenomenon in ordinary telephony is known as "howling" and is due, of course, to the presence of local free energy, of battery or amplifier, which will maintain circulatory oscillations of the acoustic and electrical effects.

At present the efficiency of these crystals, as defined by the ratio of the *output* to the *input*, is not high. This is principally because of the difficulty of associating a perfect *housing* with the crystal. The housing, is, of course, necessary in order to translate vibrations to or from the crystal. The efficiency becomes greater only when the frequency of the applied vibrations is close to that of the natural frequency of the combined crystal and its housing. Hence the comparatively large values of the alternating currents and potentials generated by the crystal when it is operated near any of its resonant frequencies—for, it may have several modes of vibration.

Some day it may be possible to pick up a pebble from the beach, place it to the ear and listen to voices spoken to another pebble found on some other shore.

[*As transmitters and loud-talkers, these crystals produce remarkable results and the amateur will be well repaid by his results, provided he follows the instructions given in this paper. As detectors for wireless telegraphy, however, they are practically valueless, if used in the regular way. Perhaps some amateur may some day hit upon a scheme which will produce the much-looked-for perfect crystal.*—EDITOR.]

Electric Sign With Indirect Lighting

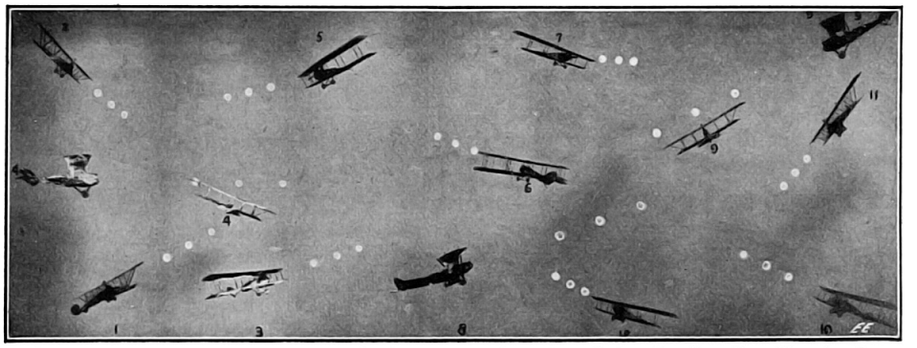
The accompanying illustration of an electric sign, and which is mounted on the north side of 73rd Street and Broadway, New York City, involves a new departure of electrical advertising displays of this type. Instead of outlining the forms of the letters on the sign with electric light bulbs or illuminating the entire sign by indirect or flood lighting, reflected on to it from long reflectors placed at the sides and at the top, as is quite common practice, the letters themselves in this new sign form

One of the Newest Wrinkles in Electric Sign Design Is That Here Shown. The Letters Stand Out in Black Relief Owing to the Arrangement of the Lamps, Which Are Placed in Back of the Hollow Letters, as Illustrated in the Sectional View.

the reflecting troughs, in which the lamp bulbs are mounted. The inside surfaces of the hollow letters are painted white so as to serve as reflectors. The lights are supported at a short distance from the sign itself by means of iron rods as shown in the detail illustration herewith. In this way the letters seem to stand out in relief on the face of the signboard, and give a very pleasing and mysterious appearance indeed. The effect is much the same as that obtained when looking at an ordinary photograph, and then viewing a stereoscopic photograph of the same view or object with the aid of a stereoscope, when, of course, the images on the photograph appear to stand out in bold relief.

Aviators Instructed on Electric Chart

Many ingenious devices as well as moving pictures and electrical chart boards, and especially illuminated maps, were devised and employed in training American aviators during the World War. Some of these rendered such excellent service and gave so much promise that they have been retained and improved upon for utilization in the regular aviation training schools of the Army and Navy Departments. One of the most difficult things which the military or naval aviator has to learn is to shoot accurately while flying in the air. To the layman this may sound quite simple, but it is far from being such, and the experts who train aviators for this duty know it.



Clever Electric Chart Board for Instructing Aviators in Firing at Enemy Planes. After the Dummy Machine Gun Has Been Sighted, the Lights Are Flashed On and the Gun Is Checked With Them.

One of the methods used for instructing the soldier aviators in which electricity played its part is here presented. The bright spots indicate the positions of small incandescent lamps behind the screen on which the airplanes appear in various flying attitudes. These were all flashed on for the picture, but ordinarily are not visible. Aiming and firing practice is accomplished by sighting a dummy machine gun at the position ahead of the plane, so that the time of travel of the bullet will be the same as that of the plane, and therefore it will reach a vital spot. After the sighting is completed, the lights are flashed on and the gun setting is checked by them. The three spots indicate the correct setting of the gun for various plane speeds of 75, 100 and 125 miles per hour.

"Casting" Motor Windings

A new type of rotor with cast winding, which has been recently designed by one of the leading electrical concerns, presents new features and improvements worthy of notice.

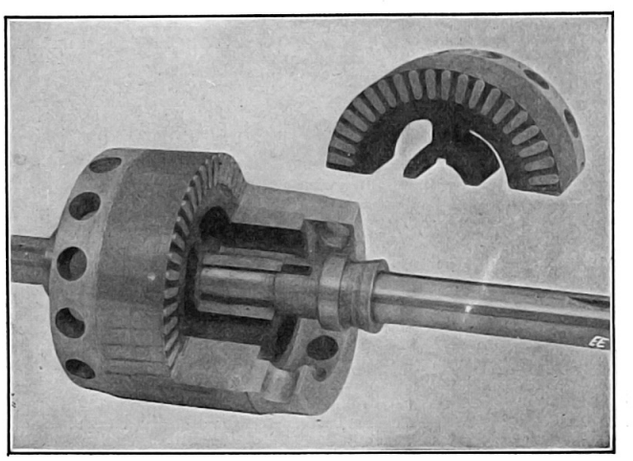
The bars and short-circuiting rings comprising the windings employ the same material and are cast in a single operation. With the windings thus made a solid unit, rigidity, durability and better balance is produced. The cast winding from an electrical point of view also insures uniform cross section and union between the bars and the end rings. This has become a factor in eliminating operating difficulties due to open-circuiting of joints between bars and end rings.

Holes bored radially thru the cast end rings give effective ventilation for rotation in either direction.

The new cast winding rotor is said to be especially effective on induction motors of the *Squirrel Cage type*. The illustration shows a sectional view of the cast rotor.

The American Electrical Manufacturer Is Always Intent Upon Producing Machinery in Large Quantities and One of the Latest Departures in This Direction Is in the Form of a "Cast" Motor Winding. This Particular Cast Motor Winding Is a Squirrel-Cage Rotor for an Alternating Current Induction Motor. Not Only Is This Idea Mechanically Advantageous, but It Is Also Said to be Very Superior in the Electric Efficiency Achieved.

Each year sees more and more the mechanical manufacture of such parts of machinery as this.



Beauty by the Kilowatt

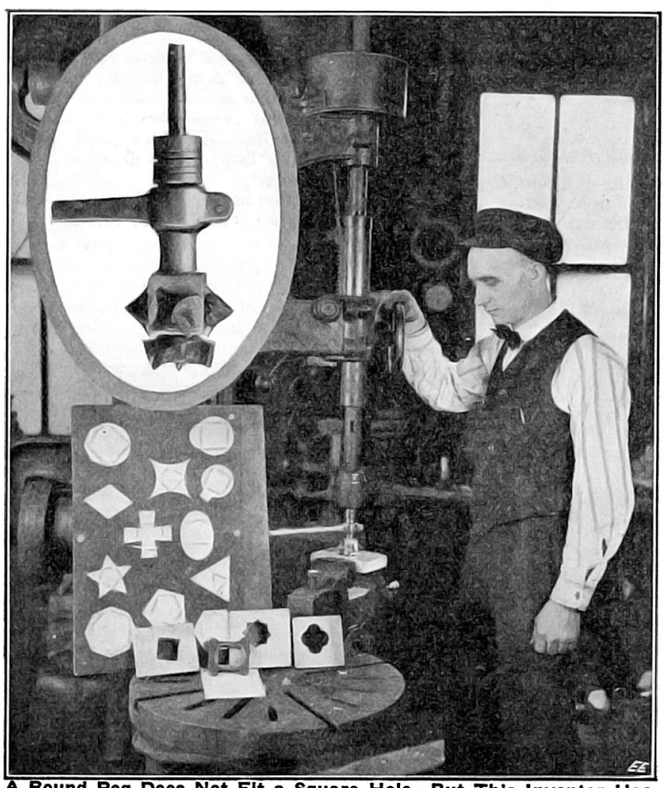
London, England, Has Started on a New Road to Fame—Making Women Beautiful by Electric Tattooing! A Permanent "Peaches and Cream" Complexion Is Yours, Gwendolyn, for Six Bits.

We have always been under the impression that the English women were blest with one of the finest complexions in the world, but here comes a cable from London telling of the popularity accorded to a new fad in the English city—that of electrically tattooing a permanent complexion or blush on the face. The report goes on to say that the pallid and sallow faces of London women are being permanently brightened and given a rosy tint by expert tattooists, whose electric needle applications can be graduated to suit any physiognomy, and further, that the tattooists report they have never done such a thriving and profitable business among women as now.

Howsomever, and be that as it may, our artist has depicted in the accompanying illustration one of London's fair damsels receiving the electric tattooing treatment for a permanent rosy complexion. Such an outfit comprises an electric tattooing needle operated from a battery and supplied with current thru a flexible wire, while a small rubber tube leads thru the needle proper to whichever complexion is selected by the customer. In some of these tattooing needles the coloring pigment is contained in a small hollow chamber on the base of the needle itself. We presume this fad will cross the ocean and become a new art on Broadway—the lane of many brilliant accomplishments, the least of which is Beauty.

Drill Bores Square Hole

Did you ever have a dream of a drill that would bore a square hole? All of us have at one time or another, perhaps. An auger *to bore square holes* has at last been invented by Carl H. Schmidgall of Peoria, Ill. The simple tool works its way by rotary motion thru wood, iron or stone. It is really five augers in one—four little conical rotary cutters milling out the corners of the square after the main shaft has bored a round hole. Drilling a square hole thru a one-inch piece of marble by present methods takes four hours or more of careful work by a skilled man. The new invention does it in five minutes. There are only a dozen parts in the machine, and, according to experts, it can be manufactured at a comparatively low price. A simple variation in the shape of the cutters makes possible the boring of holes of many different shapes.



A Round Peg Does Not Fit a Square Hole—But This Inventor Has a Circular Drill That Bores a Square Hole.

Mr. Schmidgall has been working on his invention since he was twelve years old. He is now twenty-nine, and operates the biggest hand-made tool shop in Illinois, outside of Chicago. Master mechanics from all parts of the United States have recently visited his shop to look at the square hole auger.

HANDLESS, HE USES TELEPHONE.

In the latest bulletin as issued by the American Red Cross we come upon the remarkable story of a man whose arms were amputated midway between the elbows and wrists. The best way to tell his story perhaps would be to quote directly what this man has done and is doing:

"At the time of the accident the oscalcis was removed from my left heel with tendon of Achilles. A brace made of steel, leather, and felt is a substitute for the tendon of Achilles, and with it I can walk several miles every day with ease. I frequently walk five miles just for the joy of walking.

"I have the following implements, each of which has a fitting that is an exact duplicate of the butt ends of the hooks. These hooks and the implements fasten into the wrist plates of the artificial arms with a spring catch, so that I can release either or both hooks and insert the other implements at will:—Knife, fork, and spoon for eating; hair brushes; tooth brush; whisk broom and hat brush; blacking brush for shoes; Gillette razor and lather brush; tooth-pick; fountain pen; match-holder; telephone-holder.

Without Hands—He Uses Telephone. A Striking Example of the "Reconstruction" Work on Crippled Soldiers Being Performed by the Red Cross Hospital Experts. Soldiers Without Arms or Minus Perhaps One or Both Legs, Are Being Trained to Do Most Everything Any Normal Man Can Do. They Are Taught Clerical Work, Drafting, Painting, and Many Other Arts and Trades.

"On the dressing table in my bedroom, I keep a pair of extra long hooks with which I put on and take off collar and necktie. The remainder of dressing and undressing is not with the standard hooks which are not long enough to reach collar button at throat. I button the collar at back of neck before I put the shirt on. I dress in about twenty minutes and undress in about half that time. Shaving takes from twenty-five to thirty minutes, depending on condition of razor. I do this entirely alone, washing and drying face afterward, taking the razor apart and drying it and changing razor blades when they are dull. Brushing hair and clothes, attending to teeth, and shining shoes are simple matters.

"I meet with little difficulty in telephoning, or the ordinary routine of desk work. Have been receiving good living wages for more than twelve years.

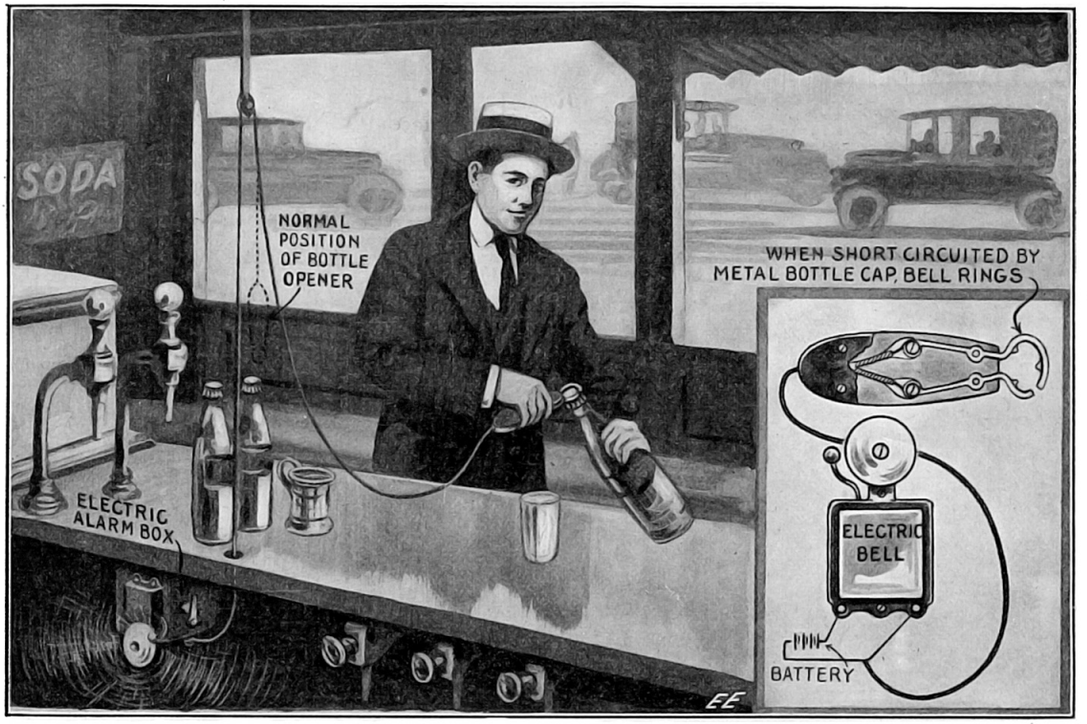
"About four years after my accident, I married one of the several nurses that helped care for me in the hospital. We have four children."

Thus the great work goes on—every day sees new and more remarkable developments in helping the lame to walk and the sick to get well.

Soda Water Bottle Alarm

The thousands of owners of small soda water stands all over the country annually lose hundreds of dollars due to people helping themselves to the various drinks when the proprietor is conveniently absent. To mitigate this loss to the owners of soda water stands the inventor, Mr. Charles F. Scarborough, has brought out a clever, electric alarm which is combined with a bottle-cap opener in the manner here shown.

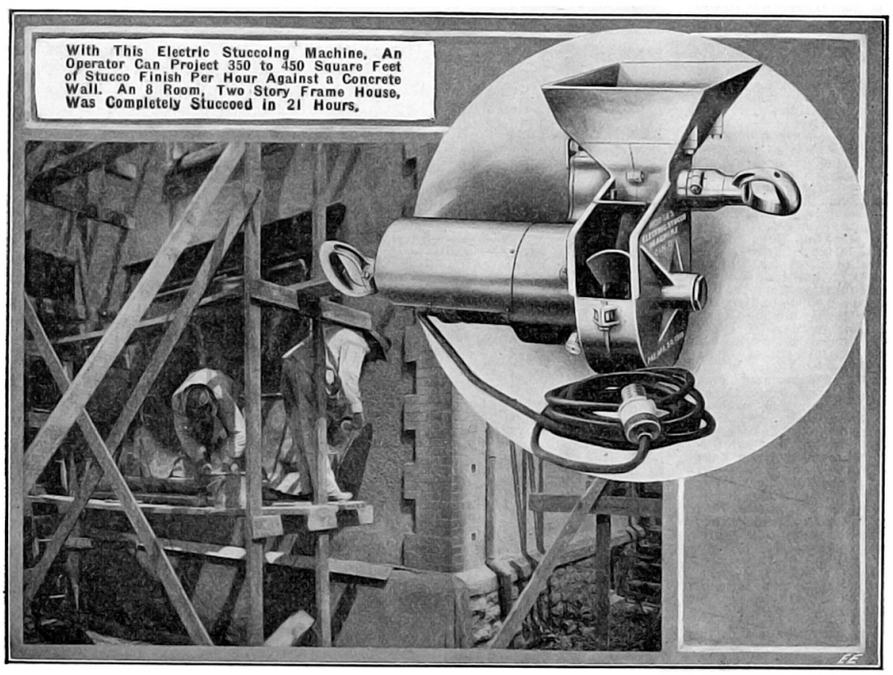
The alarm apparatus comprises a dry cell battery and bell mounted in small box, which can be placed out of sight so far as the customers are concerned. A flexible duplex wire or cable leads from the alarm box to the bottle-cap removing device. This cap remover comprises two distinct and thoroly insulated metallic rings which are connected to the bell circuit. If the circuit is closed as would be caused by a piece of metal coming in contact with the two metal fingers of the cap remover, then it will sound the alarm. Such soda bottles are usually opened up by a regular cap-remover and to make sure that the person desirous of stealing a drink, will use the electrified bottle opener, this is placed in as conspicuous a position as possible as the illustration shows. He grabs the cap remover, and the minute that it is placed in contact with the metal cap of the bottle, the circuit is closed—the bell rings, thus notifying the proprietor that he has "customers".



An Electric Soda Water Bottle Alarm, Which Has Recently Been Patented. It Comprises Two Electric Contacts Fitted in an Insulating Handle, Which, When Short-Circuited by the Metal Cap on the Soda Bottle, Will Cause the Bell to Ring.

Stuccoing Houses by Electricity

A recent house-finishing development is a motor-driven stucco machine by which the material is applied by projecting it from the machine by centrifugal force set up by revolving spider blades. The manufacturers of this device state that by applying the stucco in this manner, a skin, or enamel, is formed, making an outside coating which is impervious to moisture. As an instance of the speed at which the machine works it is said that an operator with a helper to supply the material can project 350 square feet an hour against hollow tile, brickwork or concrete blocks, and a trifle less against such material as metal or wood lath. The equipment is light in weight, aluminum castings being used for the frame and tool steel for the revolving spider blades and automatic feed. The weight of the motor, therefore, represents the greater part of the total weight of the machine. An auxiliary hopper is provided by which pebbles, crushed granite and similar materials can be effectively thrown into the stucco base.



All of the work on an eight-room, two-story frame residence, including piazza posts, was accomplished with one machine, and the actual running time of the machine in completing the entire contract was just 21 hours. The lapsiding was not removed, but is covered with a saturated felt paper, against which was nailed the metal lath and the stucco then applied. The metal lath was completely imbedded within a projected depth of 5/8", and after being roughly floated, the white stucco finish effect was projected with the machine.

The following will be found a conservative average estimate of stucco projected by this clever machine.

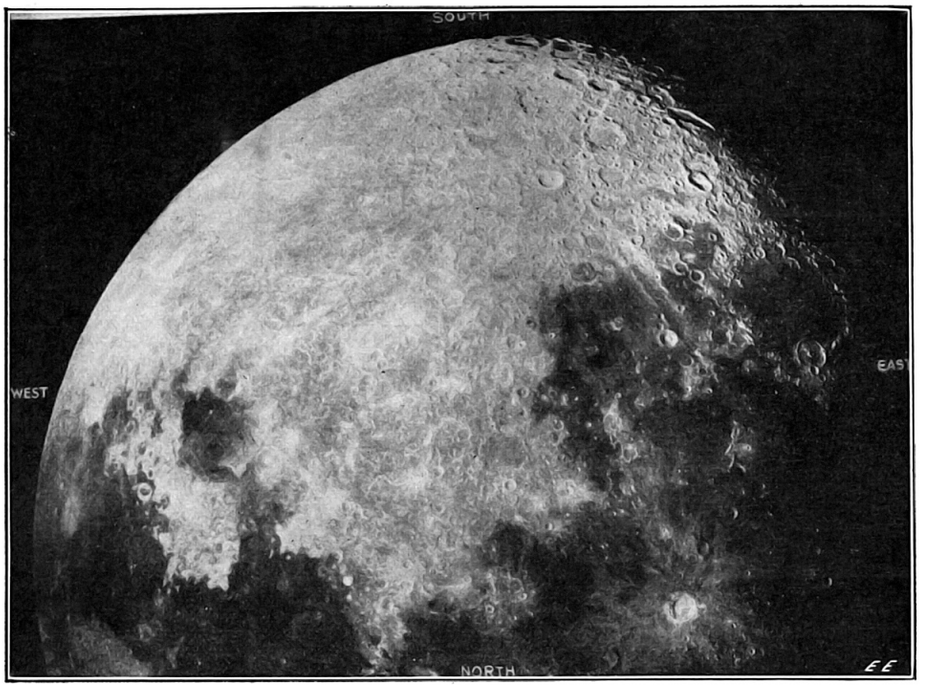
Against a poured concrete base, a coat of stucco from 1/4" to 3/8", an operator should project 350 to 400 square feet per hour; against unpainted brick, hollow tile, concrete blocks, and like materials or construction from 300 to 350 square feet per hour; against Bishopric Board and like wood, lath backing, in filling up the keys and projecting as above, 300 to 350 square feet per hour; against Gypsum Plaster Board and other like materials from 400 to 450 square feet per hour.

Against Metal Lath furred out 1/4" with a backing of building or tar paper applied to a sheeted surface or studding, 350 to 450 square feet per hour.

Popular Astronomy

By ISABEL M. LEWIS, M.A.
Of the United States Naval Observatory

IS THE MOON A DEAD WORLD?



Photograph of the Moon Taken with the 60-Inch Reflecting Telescope of the Mt. Wilson Observatory Showing Regions of Albategnius and Hipparchus. This Photograph of the Moon Shows All the Varieties of Walled-Plains, Ring-Plains and Craters as Well as a Number of Conspicuous Clefts and Rills. Almost Exactly at the Center Is the Walled-Plain Albategnius, 65 Miles Wide, and Adjoining It on the North Is the Walled-Plain Hipparchus Nearly 100 Miles Wide. This Is One of Many Walled-Plains That Clearly Show Signs of Wreck and Ruin. Note the Superimposed Craters of a Later Origin. Just to the Northeast of Albategnius Is the Great Walled-Plain Ptolemaeus, 115 Miles Wide. In Its Interior to the Northwest Is a Very Conspicuous Little Crater 4 Miles in Diameter. Almost Due North of Ptolemaeus Is the Typical Ring-Plain Herschel, with a Rampart Rising Nearly 10,000 Feet Above a Dusky Floor From Which Rises a Central Mountain Peak. The Rampart Is Symmetrically Terraced Both Within and Without. To the Northwest of This Ring-Plain Is a Deep Lunar Valley About 80 Miles Long and in Places 10 Miles Wide. South From Ptolemaeus Extends a Long Chain of Great Walled-Plains Reaching to the Southern Border of the Photograph. Near the Western Border Which Marks the Terminator Appear Ring-Plains and Craters in the Greatest Profusion and the Harsh, Black Lunar Shadows Are Very Conspicuous. The Distinction Between Walled-Plains, Ring-Plains and Craters Becomes Clear From a Careful Study of This Photograph.

SUSPICIONS that changes are continually taking place in certain surface markings of the moon have been held for many years and as the face of our nearest neighbor and satellite is scanned more carefully from year to year with telescopes of high power these suspicions are being confirmed, rather than disproved, by many diligent and careful observers.

It has been estimated that at an elevation of about one mile above the surface of the moon the density of its atmosphere is only one ten-thousandth that of our own atmosphere at an equal elevation. It is, therefore, impossible for water to exist in the liquid form on the moon at moderate elevations, tho it may exist in the form of water vapor, hoarfrost or snow.

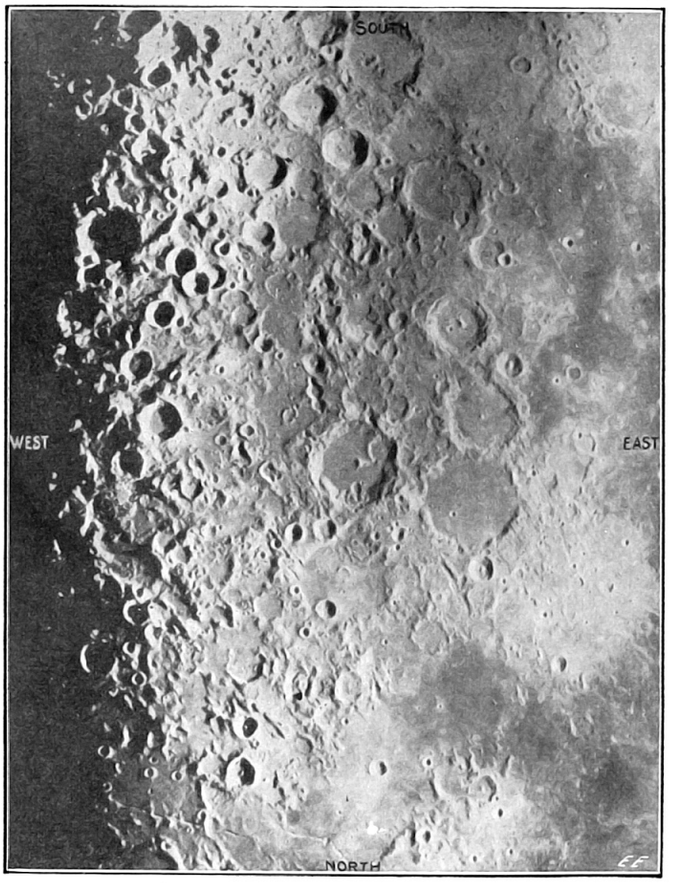
Comparatively recent researches of Very indicate that the highest temperature to which the surface of the moon is heated in the middle of the long lunar day, equal to fourteen of our own days in length, is probably about 200° F. During the long lunar night the heat rapidly escapes owing to the extreme rarity of the lunar atmosphere and within a few hours the temperature probably drops far below zero and at the lunar midnight may approach closely to the absolute zero of interplanetary space or —473° F.

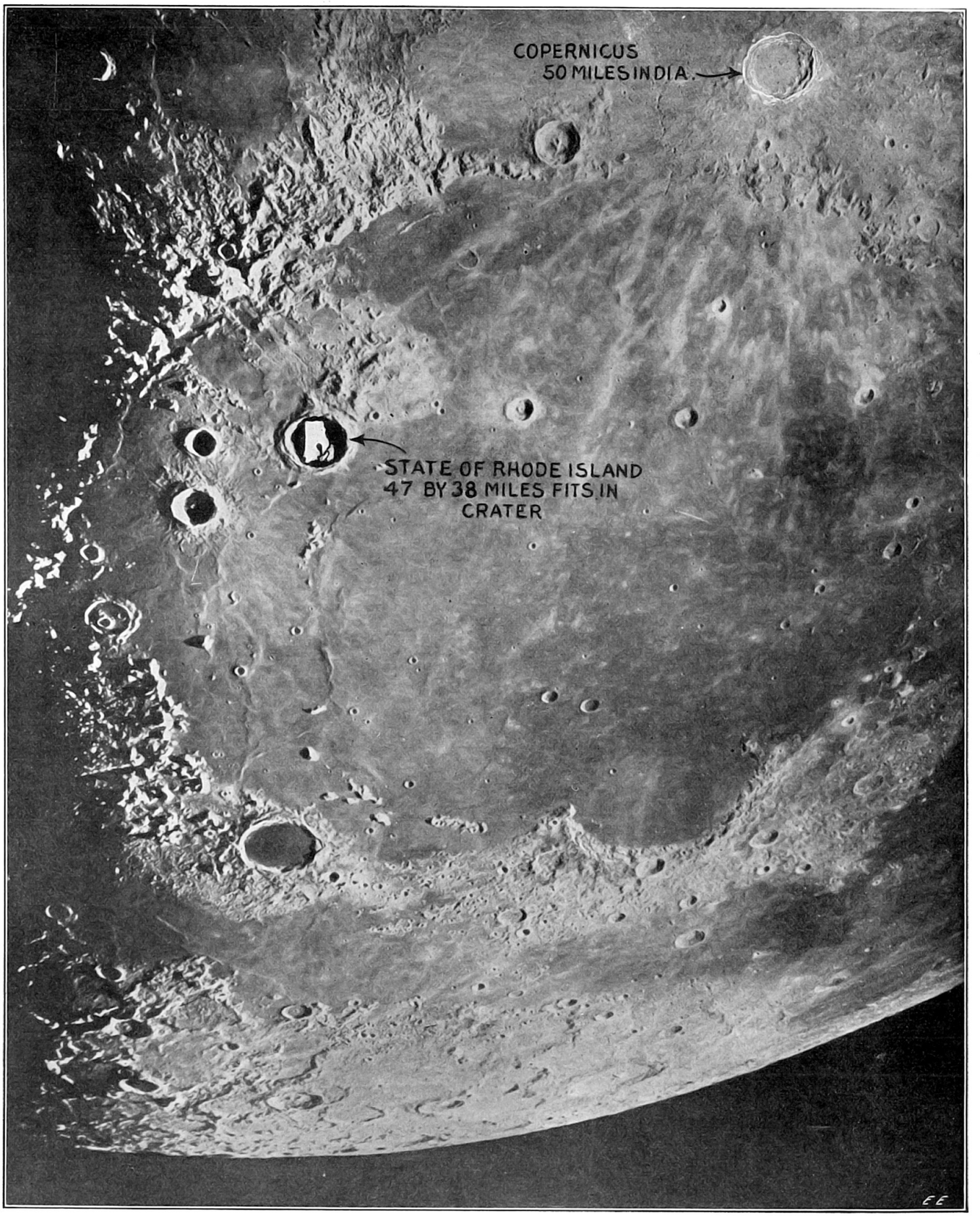
If there were no other causes to produce changes in the lunar surface markings, it might be expected that these great extremes of heat and cold alternating periodically would register their effect upon the face of our satellite.

The evidence of change in the appearance of lunar features, aside from the expected and periodic changes due to variations in the lunar phase and altitude of the sun, which are of course not changes in the markings themselves, is to be found chiefly in connection with the more minute markings such as the crater-cones and

(*Continued on page* 820)

An Enlarged View of the Moon Taken by Ritchey With the 40-Inch Yerkes Refractor Showing Ray System of the Ring Plan Tycho (to the South), and of Copernicus, One of the Most Conspicuous and Magnificent of all Lunar Features (to the Northeast, Near the Lower Rim of the Photo). The Dazzling Whiteness of the Southwest Quadrant of the Moon Contrasts Sharply With the Dark and Comparatively Smooth Maria or Seas to the North and East. The Nearly Enclosed Sea, Mare Humorum, is Shown Near the Center of the Eastern Rim of the Photo. Its Area is Approximately 50,000 Square Miles. The Walled Plain Gassendi, on its Borders, 55 Miles in Diameter, is One of the Most Beautiful Telescopic Objects on the Lunar Surface. A Lunar Mountain Range, the Riphaean Mountains, is Shown a Little to the Northwest of the Mare Humorum. The Highest Peak is About 3,000 Feet Above the Surrounding Region, Which is a Very Moderate Lunar Elevation. This is One of the Least Important Lunar Mountain Ranges. Close to This Mountain Range is the Little Crater Euclides, 7 Miles in Diameter, One of the Most Brilliant Objects on the Lunar Surface; the Region Surrounding the Crater is Equally Brilliant. The Ray Systems of Tycho and Copernicus are the Most Conspicuous of These Peculiar Markings Which are Found Associated With a Number of Other Lunar Craters. According to Prof. W. H. Pickering, Who Has Very Carefully Observed Them Under Excellent Observing Conditions, the Rays of Tycho do not Come From the Center of the Crater, But Originate in a Number of Minute Craters That Lie on the Outer Rim; While the Rays of Copernicus Originate in Craterlets Lying on the Inner Slopes of the Ramparts, Ascend to the Summit and then Spread Out Over the Surrounding Mare in Feathery Streaks.

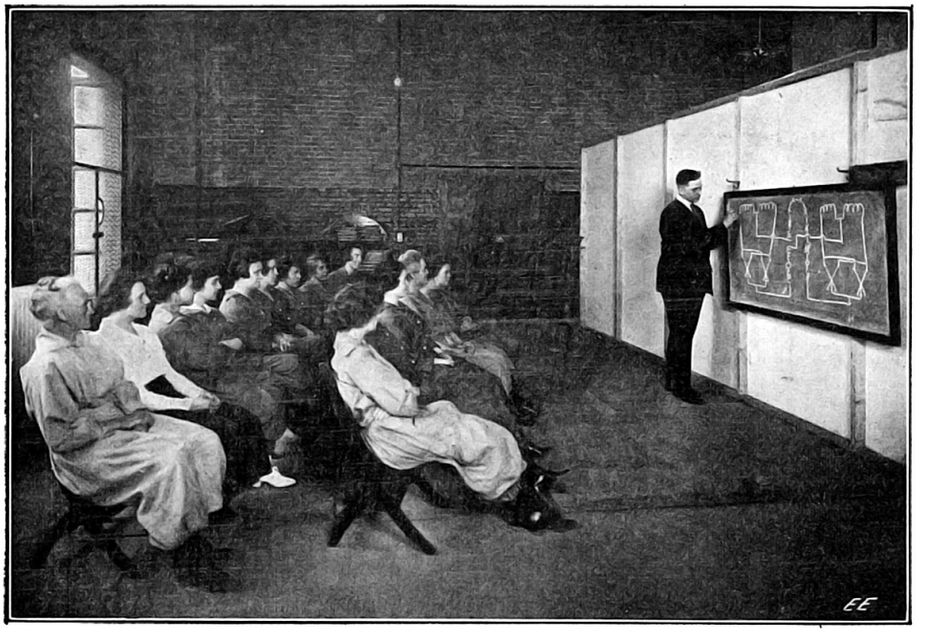




Wide World Photos

The World's Great Satellite at Closer Range Than Ever Before Seen by the Eyes of Man Was Made by the New Hooker Telescope of Mount Wilson Observatory of the Carnegie Institution of Washington, Just Installed, and Was the First Taken After the Telescope Went Into Commission. The Picture in Detail and Definition Is Superior to Any Hitherto Made. The Mirror of the Telescope, the Largest Yet Constructed, Is 100 Inches in Diameter. The Scale of the Illustration Is About One Hundred Miles to the Inch, or a Little Less Than Eight Feet to the Moon's Diameter. The Mountains Above and to the Left Are the Lunar Apennines; Those on the Left Below the Centre Are the Alps. Both Ranges Include Many Peaks From 15,000 to 20,000 Feet in Height. The Ring-like Formations Are the So-Called Craters, Most of Them Far Larger Than Anything Similar on the Earth. In the Upper Right Corner Is Copernicus, About Fifty Miles in Diameter. The Largest of the Conspicuous Group of Three Just Below the Apennines Is Archimedes, and at the Lower End of the Alps Is Plato. Attention Is Called to the Long Sunset Shadows Cast by the Isolated Peaks on the Left, and the Shadows Cast Within the Craters by the Crater Shells Can be Plainly Seen. The Central Portion of the Picture Is a Vast Plain, the Mare Imbrium.

Training Women Sub-Station Operators



Sister and Auntie Go to the Electric School—It Happened in Boston—and Learn All About Dynamos and Motors, and How to "Parallel" Alternators; What a Synchronous Motor Is; What to Do When a Circuit-Breaker "Opens"; Yes, They Learned Easily, Says Their Instructor.

The accompanying illustration shows women substation operators being trained at one of the power stations of the Edison Electric Illuminating Company of Boston. We do not usually associate electrical diagrams, circuit breakers, dynamos and storage batteries with women operators, possibly because we are not used to them, and being used to anything is mostly nothing more nor less than a habit. As we become used to these newer adventures of the fair sex in the electrical and mechanical branches of applied science, we shall, after a while, think nothing of it. Women substation operators have served faithfully and well in many power stations in England during the war, and undoubtedly will continue to serve in these capacities. It is a common practice both in this country and abroad for all women operators running power houses and substations to wear modified overall suits, so as to eliminate the danger of loose clothing being caught in any moving machinery. We know that women's minds are very subtle and quick to respond, and moreover they are eager and quick to learn, in any trade or art which they may set their minds on. We therefore presume that the serious-faced students of electric power house matters shown in the accompanying photo have graduated into full-fledged switchboard and dynamo operating experts.

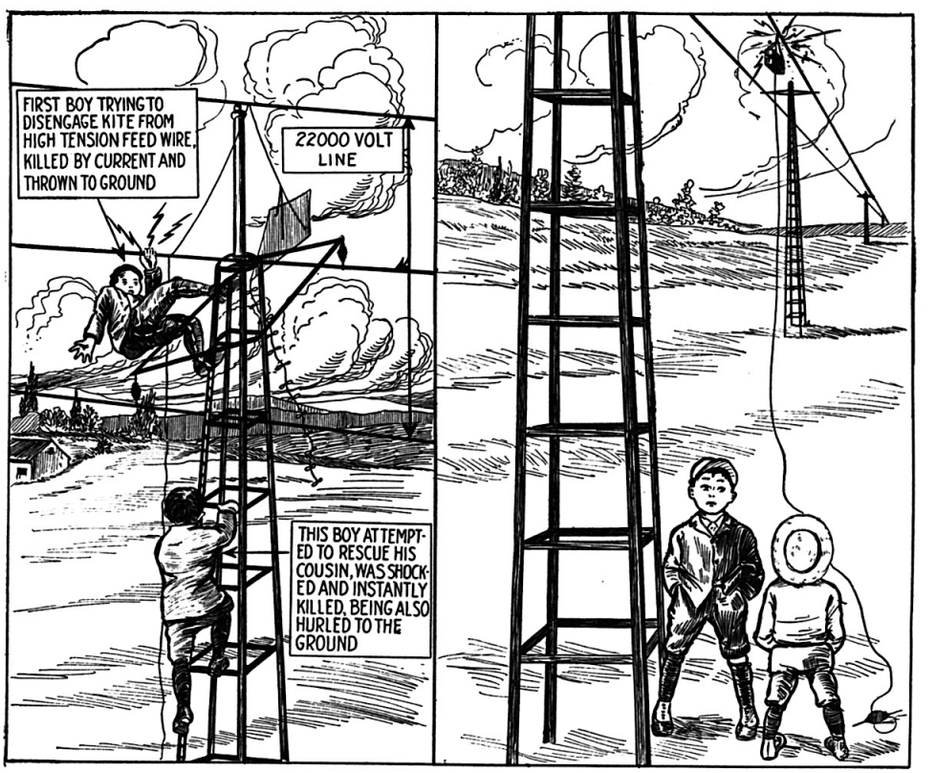
Ye scribe, having spent several long and patient years in power houses, pauses to philosophize on the mental equilibrium of the lady switchboard operators and dynamo tenders at the psychological moment when about steen thousand amperes charge over the line on a "dead short," and "blows" the breakers and perhaps the dynamos, too, with a roar like a young Niagara and flashes of fire like Pain's fireworks on the Fourth of July at Brighton Beach. And that is not all, for when a large steam main goes blooey and starts spitting out several hundred cubic feet of super-heated steam per second into the power room, they will think the end of the world has surely come; as the station fills up with steam accompanied by a deafening, seething roar as the steam escapes. But probably they will get used to these things the same as the male operators, and after one good initiation or so, never mind such little things as a 500 per cent overload short-circuit on the main generator bus-bars. We said "probably." But who can tell?

Two Kite Fliers Killed by Live Wire

Two boys came to their death recently at Winsted, Conn., as a result of contact with a high tension electric wire carrying 22,000 volts. Edward Isaacson, Jr., 13 years old, and his cousin, Walter Lindblad, also 13, were flying a kite on the elder Isaacson's farm when the kite caught in the electric wires atop a 50-foot steel tower.

The boys tried to disengage the kite and failing climbed the tower. Young Isaacson touched one of the wires carrying the heavy voltage and was thrown across the feed wire, dying instantly. Lindblad tried to assist his cousin but the current coursed thro his body and hurled him to the ground, where he was picked up dead.

The accompanying illustration shows how the current past thru the victim's body to earth. On such high tension lines all you have to do to get electrocuted is to touch one "live" wire; there is always a cross current or leak current somewhere which will complete the circuit as soon as this act has taken place. It is not safe to touch one rubber covered wire of a 2,500-volt feed circuit, let alone a 22,000-volt line. The electric chair requires only 1,800 to 2,200 volts to electrocute a man, and if you bear in mind that people have been electrocuted by touching a circuit carrying as low as 110 volts, then you will be extremely careful about touching any wires. If you are not the electrician who is *familiar* (understand that word) with the wire or pole in question, **leave it alone!** It may spell death. Electricians included.



How Many Volts Kill? Sometimes 110 Volts Will Kill; 500 Volts (Trolley Lines) Liable to "Jar" You to a Fall; 1,000 Volts—DANGEROUS! 1,500-2,000 Volts—FATAL. (1,800-2,200 Volts Used in the "Electric Chair".

Don't Fly Kites Over High Tension or Other Electric Wires. If the String Drops on the Wires, Even if Dry, You May Be Severely Shocked or Killed. Don't Touch the String—Leave It Alone.

The Amateur Magician

By JOSEPH H. KRAUS, Jr.

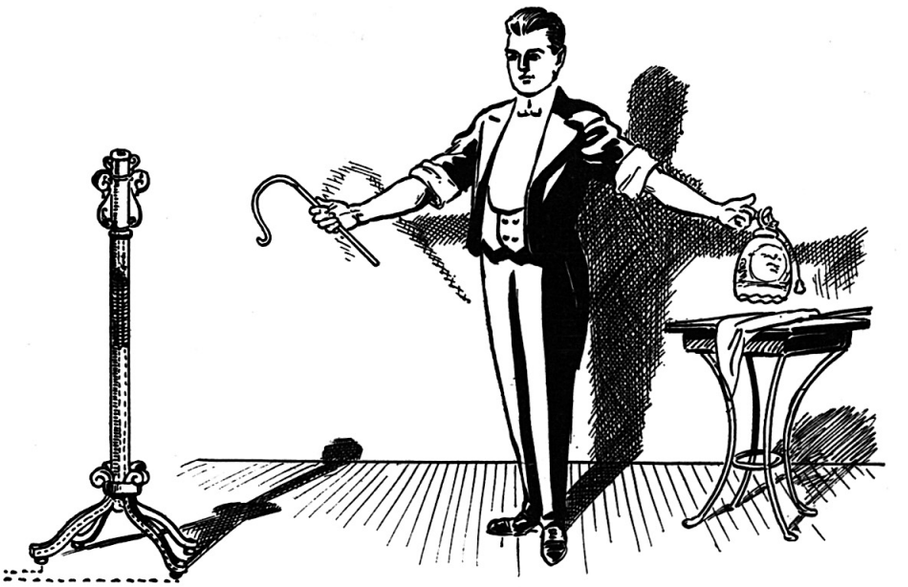
THE MAGIC BELL.

PROFESSOR HARGRAVE was known to all magicians as the originator of many ingenious tricks and sleight-of-hand passes and consequently aroused a feeling of considerable jealousy among others in the same field of work which he himself was engaged in. When, however, he made arrangements to publish broadcast those of his more spectacular tricks, the Magicians' Council, an order of the "Black Art," as that science is known, attempted to stop him, but their efforts were fruitless.

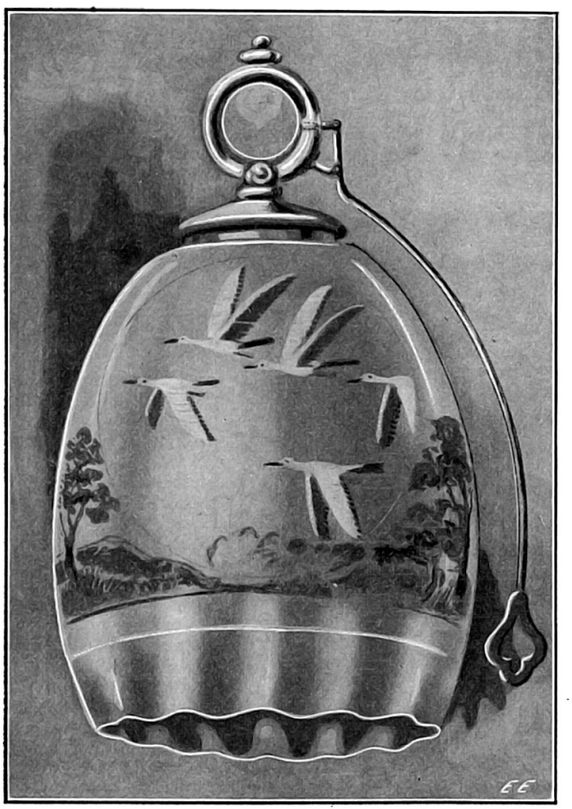
By special courtesy this publication has secured his consent for placing some of his works before the public in such a way that the lay readers who are the least handy with tools can construct apparatus to duplicate his marvelous feats. With this end in view not only the "gift of gab," or magicians' "patter," as it is sometimes called, is given, but also the constructional data are given. Let us attend one of Prof. Hargrave's performances.

"Good-morning, ladies and gentlemen," ventured Professor Hargrave, as he stept onto the stage in a recent performance at one of our largest theatres. "Evening, did you say?" he continued, "Oh, yes, to be sure it is, how absentminded I am. Well, what shall be your pleasure? This?" as he pointed to a beautiful bell hanging on a highly polished stand. "Very well."

Suiting his action to the words he reached for a pack of cards on one of the small tables and proceeded off the stage. Having had the audience select three cards,



The "Mystery Bell"—The Magician Shows That the Bell as Well as the Hook Upon Which It Normally Hangs, Including the Stand Separating the Bell, Are All Separate and Independent Pieces, Having No Strings or Electric Wires Attached to Them; Yet When the Bell Is Replaced on the Stand and Combined With the Stand Support, It Taps Out the Answers to Various Questions Asked by the Audience. It's Easy When You Know How!!!



View of the Glass Bell, Which Can be Made From an Ordinary Chandelier Shade.

he stept back to the stage again. Carrying the bell forward in full view of the audience and placing the stand right down front, he exclaimed:

"Now, friends, I don't want to deceive you." He removed the hook from the rest of the stand; passing the hook to the public on one side of the stage and the bell down the other.

"Now examine those two articles carefully and note that there are no strings to deceive you; that hook is genuine silver. I bought it myself at Woolworth's jewelry counter, an emblem of the first thing I got when I appeared upon the stage some years ago from the enthusiastic manager." (To wit—the hook!)

By this time the bell had come back and Professor Hargrave continued: "The bell answers by ringing twice for *yes* and once for *no*." Then placing the hook into its position in the remainder of the stand, and resting the bell on its hook, he added: "Don't you, bell?" to the beautiful object of glass and metal.

The bell pealed forth two melodious sounds.

"Well, bell, suppose you tell me the number of spots which were on the first card I gave out? Seven? Very well. Did the lady choose hearts?"

The hammer rose and descended twice in succession.

"Seven of hearts. Was that correct, speak out please?"

The victim answered in the affirmative.

"Thank you."

"Now, bell, will you please tell me the name of the next card? (You know I have to talk kindly to the Little Miss). How many spots were on that card?"

One ring was the answer.

"Only one? Well, was it a spade?" The response was *yes* again.

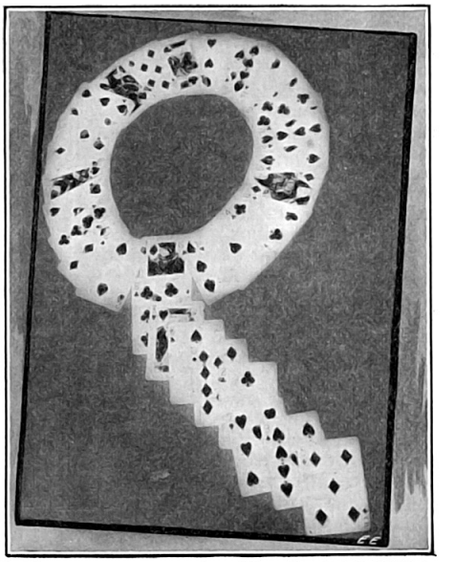
"Ace of spades, was that right, sir? Don't shake your head, because I'm too far away to hear it rattle."

"Now for the next card. Tell me the number of spots on that." Hargrave awaited an answer but no response from the bell. "What— don't you know?" The bell answered in the affirmative by ringing twice. "Well, tell me then." Again no response, whereupon the performer became excited, exclaiming: "I hope you will all excuse the bell, but I don't think she knows, so we will have to go on with the rest of the performance.

Ding-Ding, Ding-Ding, Ding-Ding.

Oh, you *do* know. Well? How many spots on it, please?"

(*Continued on page* 792)

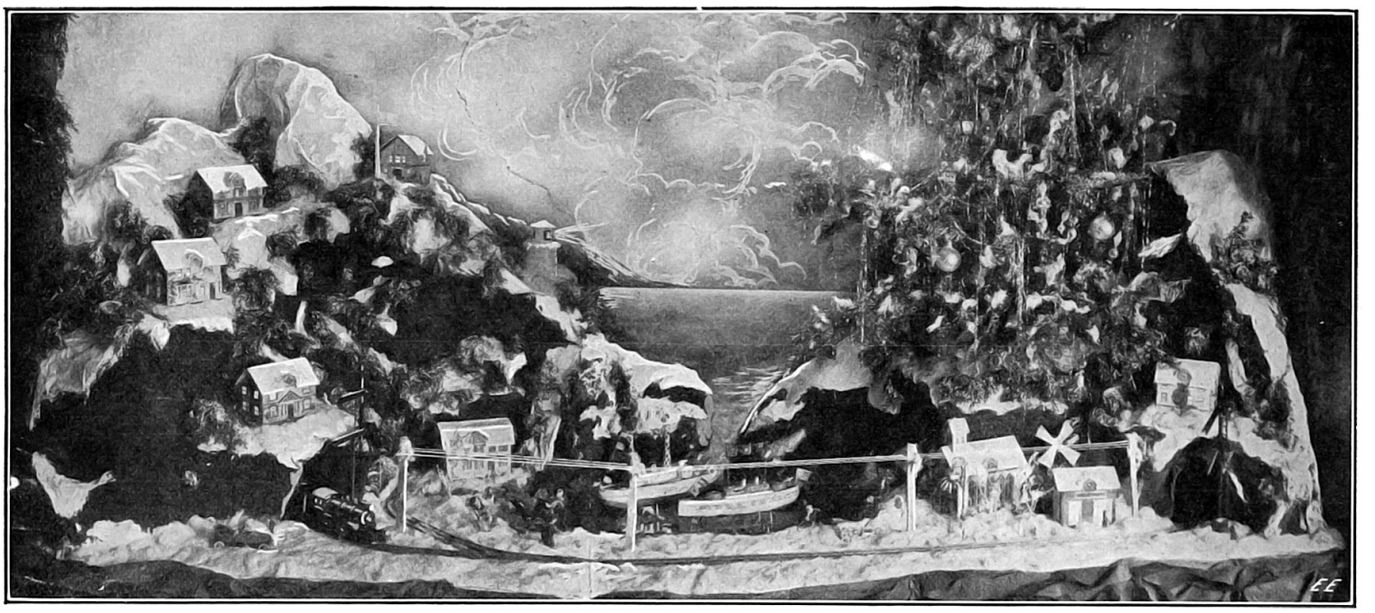


A Clever and Interesting "Card Trick" Which Anyone Can Perform at Parties and Evening Gatherings Without Lengthy Practise. The Performer Telling the Name of the Card Without Being Present. All That Is Necessary Is to Know the Number of Cards in the Tail of the "Q" Formation.

THE CONSTRUCTOR

A Model Electric Village

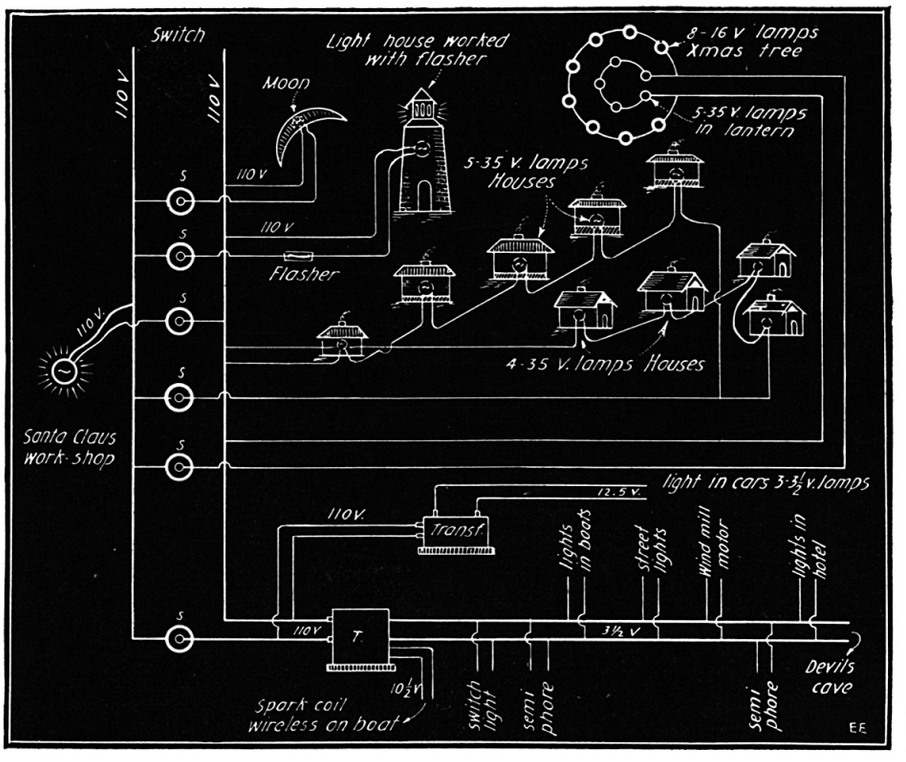
By FRED F. PHILLIPS



THE accompanying photos illustrate an electrical Christmas display that I got up for my boys, and as most of the ideas were taken from your magazine, I thought perhaps they might be of interest to your readers.

Three years ago I built a few simple electrical devices in connection with the boys' Christmas Tree, from ideas that I took from the EXPERIMENTER and the display made a "hit," not only with my own sons, but with a great many others and also the grown-ups in the vicinity. This has been followed by adding something new each year and the display here illustrated is the result of last year's work and I trust that thru new ideas gained in 1919, to build something more elaborate this Christmas.

Herewith is a diagram of wiring plan; this plan does not show telephone wires from rear of house to display in front room. I had a phonograph in the rear of the residence and transmitted music of bells and other Christmas pieces to the little church in the display. The mountains were built of wire netting over boxes and newspaper was used to cover them, the same being wet with flour paste and shaped over the wire, about 8 or 10 thicknesses were used. After it was dry, the same was painted with water color paints; white paint was used for snow and fireproof snow, such as is sold in the stores for the holidays, was used to make it sparkle. The boats are in a tank 4 feet square and 2½ inches deep; connections for lights in them and wireless on them, were run thru rubber tubing. The tank is made of tin. The light-house is made of tin and connected up with a flasher, made according to a diagram given in the EXPERIMENTER.



Wiring Diagram for Electric Christmas Tree and Village.

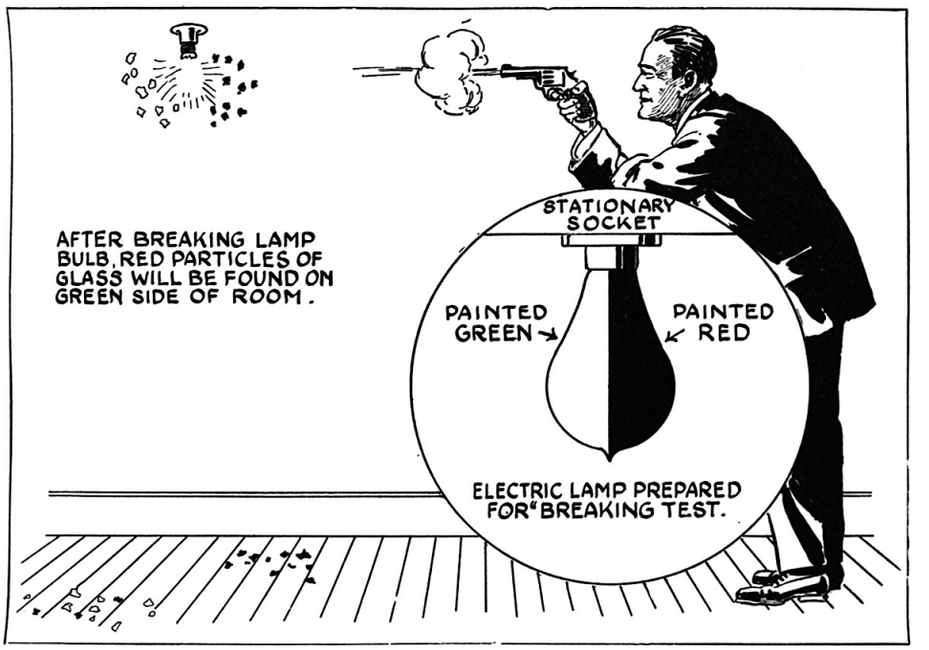
The back-ground is a piece of cheap canvas painted with water colors; inside the left-hand mountains, viewed thru a peek hole, was Santa Claus' work-shop, built on the idea of the old style candy Easter eggs. In the right-hand mountains was the "Devil's cave," where the bad boys go. This does not show up in the photo very well, as the red photographs black; it was built of red paper with lights under the same, to appear as hot coals.

The miniature houses were built of cardboard and painted to represent different buildings. The display base was 3 feet from the floor, the display itself was 9 feet long, 4 feet wide and 6 feet high from the base.

Do Lamps Burst Inward or Outward?

When an electric lamp is broken by force the glass walls are driven inward and do not fly outward as generally supposed. To prove this take a burnt-out lamp bulb and paint one half of it red and the other green. Then screw it in a socket suspended in the center of a room so that it cannot revolve. Note the direction each color is facing. Then break the bulb with a shot from a revolver or air rifle. Upon examination of the bits of glass that are scattered on the floor red particles will predominate on the opposite side of room which this color faced before the lamp was shattered, and green particles will predominate on the opposite side from which it faced also. This proves that the pressure of the air crushed the glass walls inward instead of exploding outward.

Contributed by J. A. WEAVER.

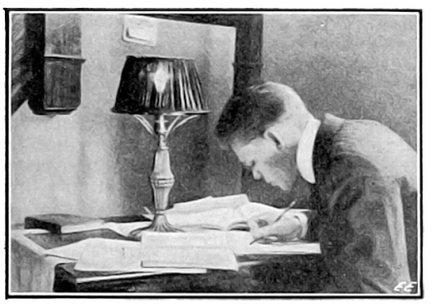


Which Way Do You Think Incandescent Lamps Break—Inward or Outward? Paint One-Half the Bulb Red, the Other Half Green and Break It with a Pistol or Air Rifle Shot. It Bursts Inward As This Experiment Shows, the Colored Fragments Falling on Opposite Sides of the Room.

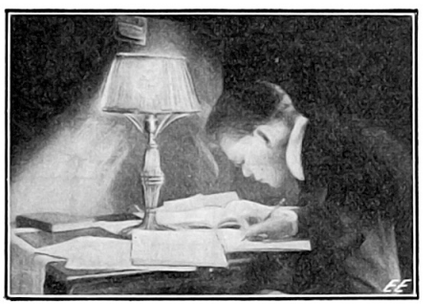
Photographic Experiments

By MARION B. REYNOLDS

"DODGING" photographs to bring out the artistic values in an apparently unartistic negative is one of the tricks of the trade which offers a great many possibilities, even for the amateur photographer. If one has either acquired or was fortunate enough to be endowed with a little patience and perseverance, plus a little ingenuity and imagination, there is no end to the variety of "stunts" one can perform with ordinary negatives.



An Ordinary Photograph by the Author—Note the Table Lamp. It Has No Glow About It.

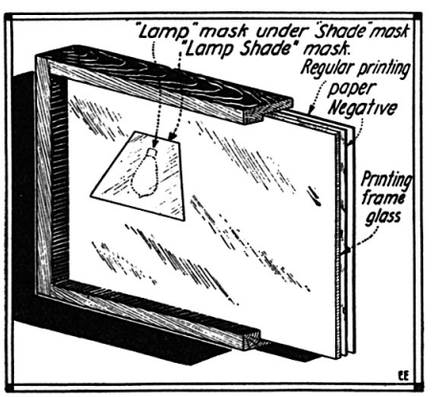


It Is Almost Impossible to Photograph a Scene Like This. By the Clever Use of a Simple Printing Mask, Such an Effect Is Readily Obtained from Any Negative.

One of these "stunts" is the introduction of artificial light in photographs snapped during the daytime, giving the effect of a picture taken in the evening. The accompanying photographs illustrate this point vividly. Obviously it is practically an impossibility to take a direct photograph giving the effect as shown in the photograph. With the average amateur's hand camera, the exposure would necessarily have to be rather long, as the only lighting used would come from a shaded lamp. A lengthy exposure would impose a trying job on the part of the sitter, as holding a position for any length of time is a difficult task and I will admit that he would have to possess a much quieter nature than I am blessed with. Then, too, halation would destroy to a great extent, the effect originally intended. This photograph was made on a bright day with a 3-A Folding Pocket Kodak, Rapid Rectilinear Lens, using Stop 16 and an exposure of four seconds. Incidentally I might say that it was taken by myself, using a black thread to release the shutter.

Printing the picture, producing the effect of a lighted lamp, was not a difficult procedure. The materials and equipment used were as few in variety as it is possible to work with and consisted entirely of amateur equipment. My printing frame glass happened to be thicker than is ordinarily used and very conveniently softened the lines of the masks used to obtain the result. The masks used need not be accurately cut as they are not used in contact with the negative but are placed on the *outside* of the printing frame glass. In making the masks, a piece of manila paper was cut to a shape resembling an electric light bulb, and another was cut to the exact size and shape of the lamp shade. In order that these masks might be placed in the correct position on the printing frame glass, the negative was placed in the printing frame and temporarily secured by means of gummed strips of paper. A piece of white unsensitized paper was then inserted in the frame so that the objects in the negative might be clearly defined. The first mask, cut to the shape of the bulb, was then placed in position with a little mucilage and the second placed immediately over it in the same manner, directly over the lamp shade in the negative, taking care to place mucilage only on the edges, making it possible to remove it without disturbing the first mask. After removing the white paper and replacing it with a sheet of sensitized paper, an exposure was made of about three seconds, using a very strong but soft light and dodging the lower portion of the negative with a triangular piece of cardboard. A second exposure was made of the same duration, but with the second mask removed, and a final exposure was made with both masks removed and without the use of the triangular cardboard. Upon developing the result, the effect was found to be just what was wanted.

Numerous other effects may be produced in this manner, such as a family circle around an open fireplace, or the rays of a light-house may be introduced in a daytime picture, turning it into a night scene. If one is willing to put a little thought and study into his experiments many other subjects and effects will suggest themselves, which if carried out will produce very pleasing results.



Showing How the Two Paper Shades or Masks Are Arranged In Front of the Printing Frame to Give the Effect of an Illuminated Table Lamp, As Shown at the Left.

The "Finer Workings" of Static Electricity

By FREDERICK VON LICHTENOW

THERE is hardly a branch of experimental electricity which requires a closer observation of its functional details than *Electrostatics.* The field itself, seemingly unlimited, not only offers a great variety of experiments, finished and complete in

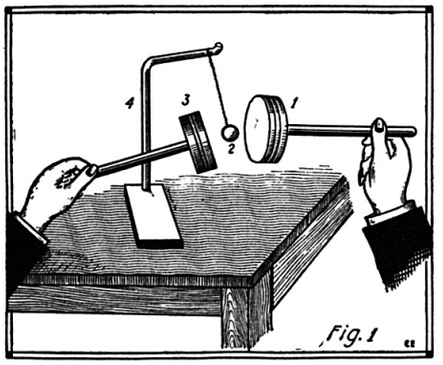


Fig. 1. Repulsive Action of Induced Charges. 1—Electrophorus Cover No. 1 (Charged). 2—Light Body (Pith). 3—Electrophorus Cover No. 2. 4—Insulating Stand

themselves and clearly demonstrating the basic principles of this element; but an additional multitude of variations from these—due to more or less marked changes in their conduction—which *in some instances* exemplify the "Finer Workings" of this earth-endowed mysterious power to a remarkable degree.

Many things about Static Electricity have doubtless remained unknown, just as well as even the action of the Wimshurst Static Machine, so long and widely used, is as yet not understood to the fullest extent.

Electrical experiments in general teach much; static experiments, however, are *in principle* and *in part* true replica of the great atmospherical movements and disturbances which occur above and around us, in consequence of which a favorable amount of conclusions regarding the latter may be drawn from these experiments. So much for static experiments in general.

Additional "clues" however, leading to the fuller understanding of this particular branch of the electrical science, may be gathered from experiments, which in a more or less pronounced way, expose the "Finer Workings" of static electricity.

Only the simplest apparatus is needed for their reproduction, in fact, weak charges-sources are a necessity to that end, since the

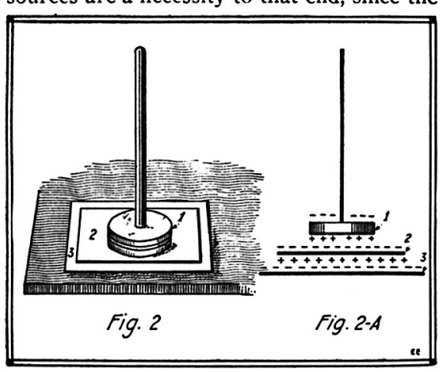


Fig. 2. Electrophorus Cover Charged Thru Glass. 1—Electrophorus Cover. 2—Sheet of Glass (1/16") 3—Hard Rubber Plate (Charged)

more powerful generators (static machines) liberate entirely too much unwanted energy (influence) into the surrounding air, as well as deliver too strong a charge into the instruments in operation, as to ever allow these very tender static actions to evidence themselves.

EXPERIMENT NO. 1.

Some light object (such as a pith ball), after suspending it by a silk thread from an insulating stand, is gradually approached by a charged electrophorus cover (a tin box fastened to a stick of sealing wax or hard rubber rod will do) until it moves toward the latter and is held under the influence of the charge in a position near the cover. "Near" means in this case the distance between the cover and the ball, when the latter, altho attracted, still hangs under *medium tension* and *will not move further on its own accord.* This has to be carefully worked out!

If now the cover of another electrophorus, *not* charged but in a so-called neutral condition, is brought near the light object from the opposite side and moved slowly toward it, the (supposedly neutral) cover will during this motion "force" the suspended pith ball ahead of itself and "push" it thru the intervening space up to the charged cover. (Fig. No. 1.)

The phenomenon finds its explanation in that the positively charged cover in attracting the light object induces a negative charge upon it as well as upon the so far neutral electrophorus-cover, repelling at the same time all positive electricity.

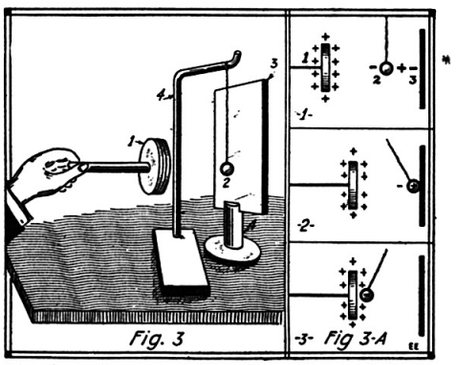


Fig. 3. Inductive Action Upon Neutral Body. 1—Electrophorus Cover (Charged). 2—Light Body (Pith). 3—Sheet of Glass. 4—Insulating Stands

(The small amount of positive electricity repelled on the light body (pith ball) is neutralized thru the air (at a distance) by the induced (—) charge on the face of the second El-cover). Both cover No. 3, and pith ball, carrying a like charge, repel one another and since this cover, which has besides the larger amount of induced charge (reflex-energy, so to speak) of the two residing upon it, is moved steadily in the direction of cover No. 1, the light object can not help but make contact with the latter.

It goes without saying, that, if the experiment is interrupted before the ball reaches the charged cover and the latter is removed altogether, the field of influence vanishes automatically, and both ball and the other cover are once more restored to a neutral condition.

The insulating stand to be used *in this experiment* should contain no metal parts and the pith ball should hang well off the table surface, as in all static experiments of a similar character.

Another way of gaining similar results—the effect, however, will be not quite so pronounced—is by employing a charged hard rubber plate instead of the charged electrophorus cover, using otherwise the same instruments and tactics. In this case, as is quite natural, the polarity of the respective parts will be found *reversed.*

If in either of the above cases the neutral El-cover is replaced by a *grounded conductor,* such as the operator's hand, for instance,

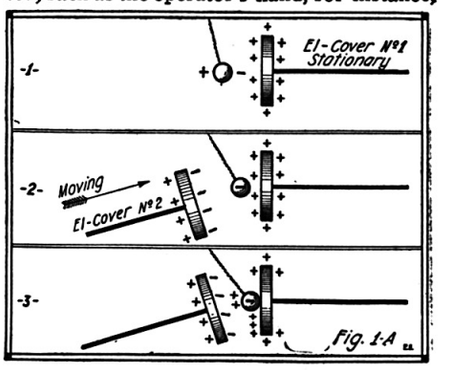


Fig. 1-A—Diagram Showing the Three Principal Stages of the Static Experiment Illustrated at Fig. 1.

which changes the fundamental principle of the experiment, then the pith ball will be first attracted to the hand (providing the latter is brought close enough to it) where the ball "unloads" its complement of positive electrons and an instant after, fully negatively charged, fly over to the + charged El-cover and make contact with it, which it, again, would not accomplish "under its own power."

Concerning the first two instances, I may further add, that, whenever the induced charge is too weak to neutralize the positive element repelled on the pith ball at a distance, the ball will (quite naturally) be momentarily attracted to the second El-cover, which in turn is a sign only, that cover No. 1 is not properly charged.

EXPERIMENT NO. 2.

(Electrophorus Cover Charged Thru Glass)

That an electrophorus cover will receive a charge, altho separated from its "cake" (charged hard rubber plate) by an insulating body, is proven by the following simple experiment:

The cover of an electrophorus (metal box used in experiment No. 1) is charged in the usual way, discharged and charged again until the sparks are raised to their

(*Continued on page* 837)

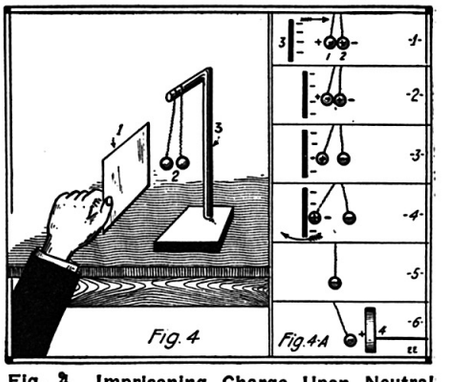


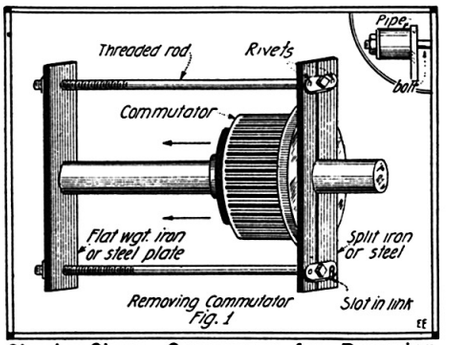
Fig. 4. Imprisoning Charge Upon Neutral Body by Induction. 1—Hard Rubber Plate (Charged). 2—Pith Balls. 3—Insulating Stand. Ball Hanging Nearest to the Plate Should Be Suspended by a Thread with a Wide Loop. Explanation for This Is Given in the Text

Fig. 4A. 1 and 2—Light Bodies (Pith). 3—Hard Rubber Plate (Charged). 4—Electrophorus Cover.

The Electrical Machinist

By H. WINFIELD SECOR

No. 2—Commutator Work (Continued)



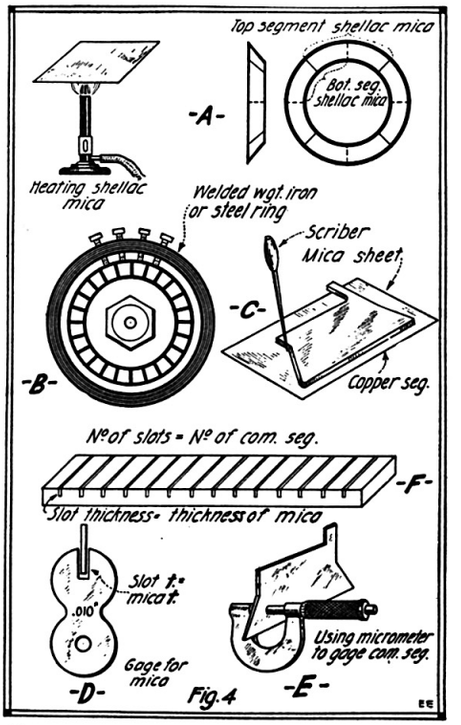
Simple Clamp Compressor for Removing a Commutator From an Armature Shaft.

IN the opening installment of this new series of articles describing the work of the Electrical Machinist, the subject of *commutators* was discust. Commutator work is of such great importance to all electrical workers, that it has been thought advisable to have this second paper continue with some interesting and practical wrinkles concerning this class of work. For the benefit of those who happened to miss the first paper, it may be said that this treated on the best methods of turning commutators in the lathe, how to repair burnt mica between commutator bars, and so forth.

Figure 1, shown herewith, illustrates a simple form of clamp for pulling commutators off the armature shaft. Of course the size of the clamp and the parts composing it, will depend upon the size of the commutator to be removed. A very satisfactory and efficient form of commutator clamp is that illustrated, wherein the plate which is placed behind the commutator is made in two parts, these parts being held together by small iron links which can be held in place by machine screws or rivets. The lower link has a slot in one side, so that when the clamp member is to be removed from the shaft, this link can be moved out of register with the pin on the one side of the clamp, thus enabling the user to swing the two clamp plates apart and thus remove it from the shaft. At the center of this spliced plate, the hole is made large enough to fit around the average size armature shaft. Two long bolts, threaded at least for half of their length if possible, are used to create the compression force to pull the commutator from the shaft. The iron plate over the end of the shaft must of course be stout enough to withstand any bending stresses.

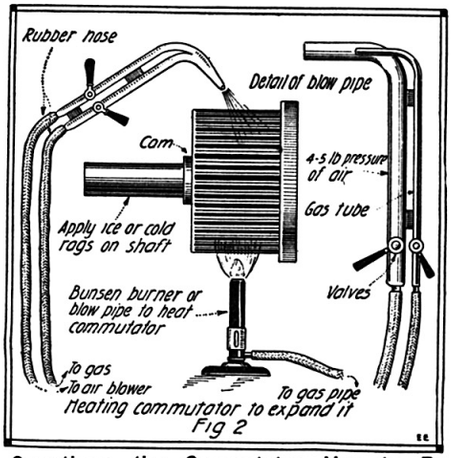
In emergency, all that is required to perform this work is two substantial blocks of wood instead of the iron bars. By means of suitable iron washers and nuts, similar results to those obtained with the iron clamp can be obtained. Where ordinary bolts are available in an emergency, it may have threads extending only for a few inches at the ends; they can be used very effectually by using washers or pipe nipples behind the nuts. When the commutator is removed as far as this action will permit, then the nuts can be backed up towards the ends of the bolts and by means of washers or short lengths of iron piping (nipples) placed under the nuts and washers, a new compression force can be utilized. Many a stubborn commutator has been removed in this fashion in actual practice.

Sometimes, a commutator will set fast on the shaft, aided by corrosion, so that it will not yield even when a powerful clamp such as that described and illustrated at figure one, is applied. Then it becomes necessary to make use of a well-known principle of physics, viz., to *expand* the outer ring or commutator and to *contract* the inner metal member within the ring, or in this case the shaft. If we expand both ordinarily, we will not gain very much toward loosening the commutator grip on the shaft, but owing to the different coefficients of expansion of the steel shaft and the commonly used brass commutator shell, we would gain something in most cases, even tho the shaft is not cooled by special means. There are two usual methods of heating the commutator,—the first being to use a Bunsen gas burner, and the

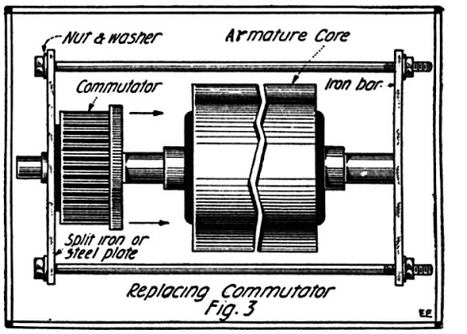


Practical Shop Wrinkles for the Young Electrical Machinist.

other a comprest air gas blow-pipe, which every electrical repair shop is fitted with. The mica and copper composing the Com-



Sometimes the Commutator Has to Be Heated as Shown, and the Shaft Cooled, In Order to Force the Commutator Into Place.



Utilizing a Compression Clamp Rig for Forcing Commutator Into Position on Armature Shaft.

mutator will stand a lot of heat and the Electrical Machinist warms up the commutator by applying heat directly to it, in order to expand it, where he deems it necessary. Of course, it should not be heated red hot or anything like that, but simply heated up only until it is hot enough to make water sizzle when a drop or two is applied to the commutator. The expansion of the commutator and a relatively large contraction of the shaft can be greatly enhanced or augmented by applying rags soaked in ice water to the shaft during the heating of the commutator and at the time the clamp is applied in an effort to remove it from the shaft. On large commutators the heat is maintained from a blow-pipe, etc., while the clamp presses are being applied in order to remove the commutator. At figure 2, there is shown an outline sketch of the comprest air and gas blow-pipe. These blow-pipes are often home-made, or can be obtained at any machinist's supply house. The blow-pipe comprises two distinct and separate tubes usually made of brass as shown, there being a valve placed at the lower end of each tube, by which the amount of gas and air can be regulated. Flexible rubber hose connects the two blow-pipe tubes respectively with the gas main and air pipe line or blower. The gas used is ordinary illuminating gas, and a small, simple form of air blower such as the cam type is satisfactory for the purpose. The blower is invariably driven by a small electric motor or else it may be belted to the line shaft. A ⅛ to ⅛ horse power motor is sufficient for driving a small single-stage blower feeding a 1½ inch pipe line to which four of these blow-pipes are attached. The air pressure required is only a few pounds, four to five pounds being about right.

REPLACING COMMUTATORS.

Some form of clamp is necessary and usually employed in replacing commutators on the armature shaft. One method of applying pressure with a clamp is shown at Figure 3. Here the two-part spliced clamp or else a solid plate with a hole thru the center, big enough to fit over the shaft, is placed against the commutator while a second plate member is applied over the front end of the shaft. Now, when the wrench is applied to the nuts on the two bolts, pressure is applied in such a way as to force the commutator on to the shaft. Right here it should be pointed out that great care should be exercised before re-

(*Continued on page 788*)

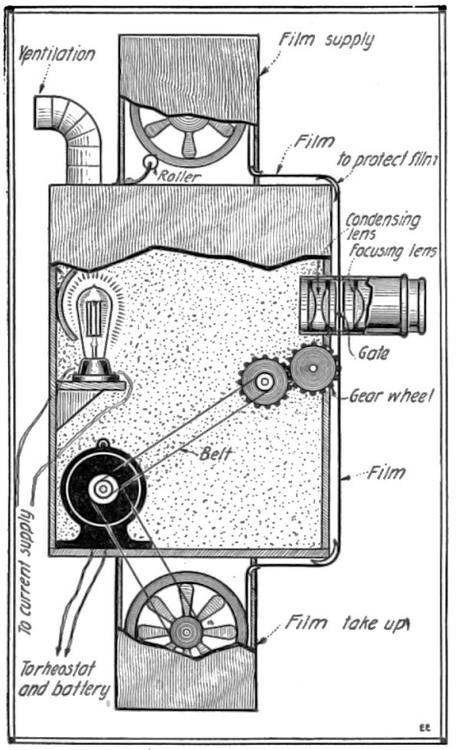
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

HOW TO MAKE AN ELECTRIC "MOVIE" MACHINE.

The condensing lens as shown in sketch comprises two plano convex lenses which can be bought at any optician's or second-hand shop cheaply. The focusing lenses are



Every Experimenter Will Enjoy Making a "Movie" Machine. This One Uses Standard Films.

two anastigmat types of a speed about f:4.5. They are each enclosed in a tube made of tin, one tube sliding in and out of the other to obtain proper focusing on the screen. These lenses can be bought all ready in the tubes or at an optician's store.

Standard film is proposed for use with this machine and since it is 1¾" wide, the film gate will have to be a little wider. The take up boxes for the film will have to be large enough to hold a coil of film 18" x 3". A strong box should be used since the film is quite heavy. The camera part will have to be necessarily larger to accommodate a small motor, lighting system and cogs and gears. A roller should be put in the lower left hand corner of the upper box to prevent the film from unwinding too rapidly. Tin should be put on the edges of the machine where the film is pulled over, or else a worn film is sure to be the result. By looking in theatrical papers you can obtain the name of a concern who sells films. The gate should be fitted with an intermittent stop motion permitting each picture to stop for a fraction of a second.

Contributed by FRANCIS E. ZIESSE.

SECOND PRIZE, $2.00

TABLE LAMP FROM TELEPHONE STAND.

A certain SPERRY had a "Sis" that always wanted something new for her Xmas. SPERRY, being an intelligent and polite gentleman, would never refuse. So this Xmas he's going to give her a cute table lamp. Here's how he went to it:

SPERRY gets into his shop, or rather, laboratory, and conducts a search. He finds a good-looking desk telephone (that is devoid of every bit but the stand)—a nickel-plated (⅜") pull-chain socket, a nickel-plated socket cap, a length of (⅜") pipe, a crowfoot for it, and some strong metal wire.

He then follows this routine: The pipe (D) (threaded) is slipt thru the stand (A) and screwed into a crowfoot (E), the crowfoot being fastened with screws to the base of the stand. The socket cap (B) is screwed to the top end of the threaded pipe, until the stand is made tight. There should be a little projection of the pipe—about ¼" above the cap (B), so that the socket (C) can be screwed to this. The shade holder is made of metal wire, or, of anything SPERRY happens to find at hand to suit him. The only trouble for SPERRY is to get the shade—it must be bought. The rinktum is then shined up and polished to a luster, and (the price tag attached) presented to "Sis."

Contributed by B. DOPPKE.

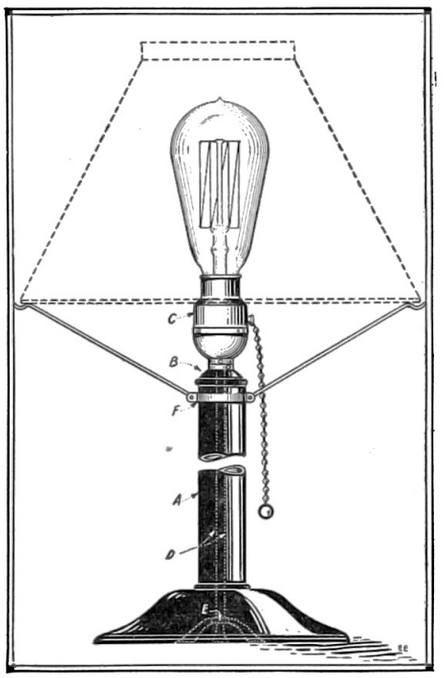
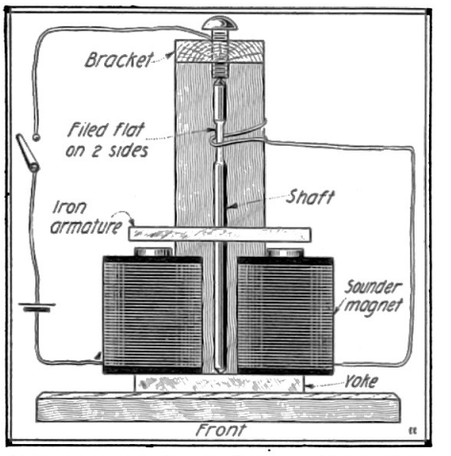


Table or Boudoir Lamp Which Anyone Can Make from an Old Telephone Desk Stand or Similar Pedestal, Together With a Few Pieces of Wire and Some Colored Silk. Old Rose Silk Outside and Blue Inside Gives a Wonderful Color Effect.

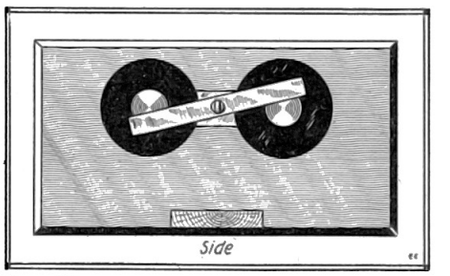
THIRD PRIZE, $1.00

A TELEGRAPH-SOUNDER ENGINE.

The following article explains how to make a simple electric engine from a telegraph sounder, a steel rod and a few pieces of wood:



Side View of Small Battery Motor Constructed From Discarded Telegraph Sounder

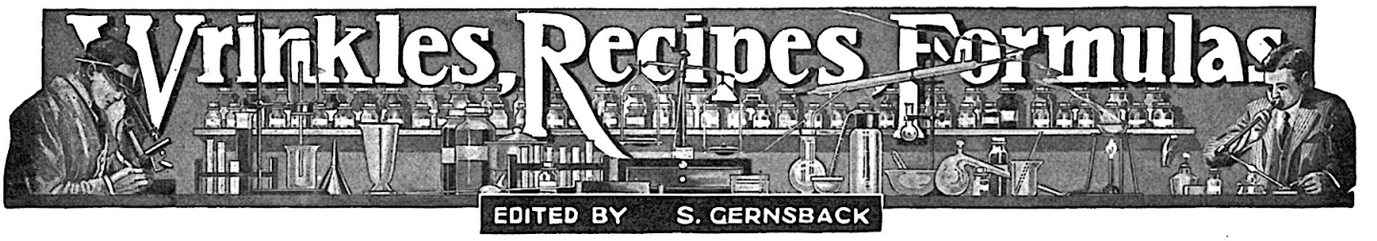


Top View of Telegraph Sounder Engine Without Upright or Top Bearing.

The wooden part consists of a base of 3 x 4 inches and upright 5 x 1 inches mounted at one end of the base, with a bracket 3 x 1 inches to hold the upper bearing screw. Mount the magnets and yoke on the base and make a slight indentation with a drill or center punch in the exact center of the yoke to form a bearing for the shaft.

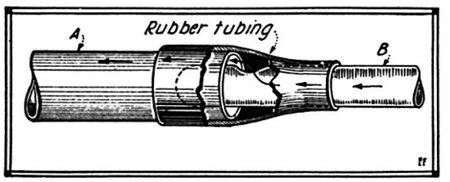
The shaft consists of a mechanical toy rod about 4 inches long. File each end to a point and also file two flat surfaces on opposite sides of the rod, about 1 inch from the upper end. The iron armature should just clear the top of the magnets, and is fastened to the rod with solder or friction only. The brush is formed from a piece of copper wire fastened to the upright and bent around to touch the flat surfaces on the rod. It should make contact twice in every revolution. It should be adjusted so that contact is made when the armature is farthest away from the magnets and broken when the armature is over the magnets. This engine will run at a very high speed with one dry cell.

Contributed by HOWARD ROLLO.



SIMPLE STOP-COCK.

The following sketch shows clearly the construction of a simple stop-cock: A and B are glass tubes, the latter having such a diameter that it will pass into tube A. It also has one end rounded, i.e., closed, and a hole in its side about 5/8-inch from the closed end. This hole is made by directing



A New Idea of a Stop-Cock. Using Just Two Glass Tubes and a Piece of Rubber.

a pointed flame (from blowpipe) at the desired spot, till red hot, and then blowing into the open end. Fuse the edges of the hole. In operation, the small tube B is moved backward or forward, i.e., into or out of the rubber tubing. It is best to have the liquid enter B, and leave A.

Contributed by RAYMOND B. WAILES.

FREEZING "WATER" BY MAGIC.

In a small Erlenmeyer flask or beaker place 50 grams of ordinary photographers' hypo and 10 c.c. of water. Heat to boiling and allow to cool. Be very careful to see that the flask is clean and that no dirt enters during the operation.

When the solution has become cold pick up the flask, add a tiny crystal of hypo and give a quick shake. Practically instantaneously the liquid congeals into a solid mass with the liberation of a considerable quantity of heat.

To the uninitiated this is a very striking demonstration. What happens is this: Photographers' hypo is a salt containing a large quantity of chemically combined water, called water of crystallization. The heat releases this water and the salt dissolves in it together with the 10 c.c. of water added. The solution, however, is what we call supersaturated and is in an unstable state of equilibrium, such that a tiny crystal of the same salt and a quick shake will drive the salt with its water of crystallization out of solution.

The heat liberated too, illustrates the scientific fact that water or any other liquid in freezing actually gives off heat.

Contributed by FLOYD L. DARROW.

IMITATION SILVER AND PLATINUM AND OTHER WRINKLES.

Herewith are a few suggestions that may be worth something to the Wrinkles, Recipes and Formulas Department:

Imitation silver: Copper, 4 pounds; zinc 4 ounces.

Imitation platinum: Copper, 4 parts; zinc, 18 parts.

Impression metal: Bismuth, 3 pounds; lead, 1 pound; tin, 8 ounces.

To separate silver from copper: Sulfuric acid (H_2SO_4), 1 part; nitric acid (HNO3), 1 part; water, 1 part. Boil in mixture and a little salt (sodium chlorid) it will subside.

Contributed by JOHN V. CRAIG.

IGNITING ALCOHOL OR ETHER WITH A GLASS ROD

In the bottom of a tumbler place a half teaspoonful of potassium permanganate and moisten with an equal quantity of water. On a glass plate pour a little alcohol or ether.

Now cover the potassium permanganate with *strong* sulphuric acid. A vigorous action is immediately set up. Upon thrusting the end of glass rod into the sputtering mixture and touching it to the alcohol or ether spontaneous combustion immediately occurs.

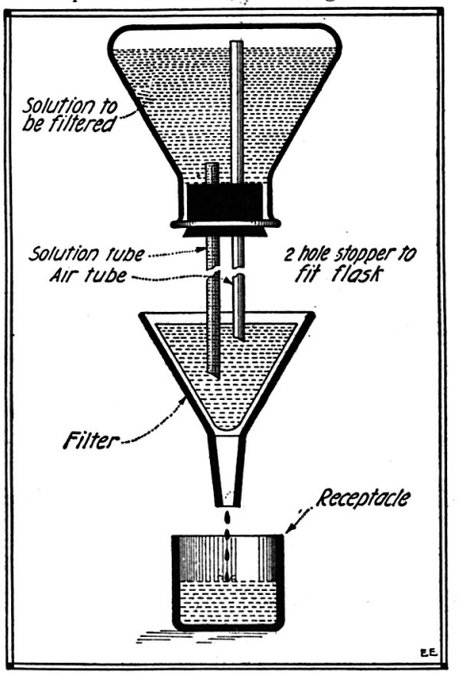
The potassium permanganate and sulphuric acid liberate ozone, a very concentrated form of oxygen, and resulting rapid oxidation quickly ignites the inflammable liquid.

If desired gasoline may be substituted for the alcohol and ether.

Contributed by FLOYD L. DARROW.

AN AUTOMATIC FILTER.

When filtering solutions which filter slowly it is very tiresome to keep refilling the funnel. The filter shown in the present drawing saves this trouble. As soon as the solution gets below a certain level in the filter, air is allowed to pass thru the air tube until the filter is filled, when the solution stops the flow of air. The air tube should be about one-half inch below the top of the filter; the length of the



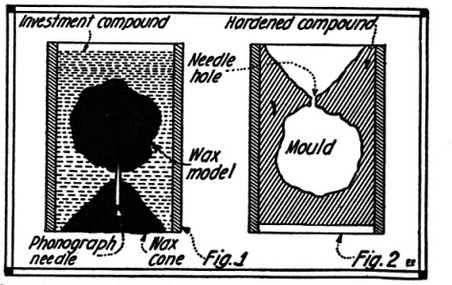
An Automatic Filter Which Once Started Will Run Without Attention Until the Last Drop Is Filtered.

solution tube does not matter. When properly adjusted this filter will refill regularly until the flask is empty.

Contributed by MORRIS TUTTLE.

MAKING SMALL BRASS CASTINGS.

Make a model of the desired size and shape from paraffin wax. Procure a piece of iron pipe about 2½ inches long and of a sufficient inside diameter to admit the model, with at least 1/8 inch clearance at all points. Now make a cone of paraffin about 3/8 of an inch high and the base of a diameter a trifle larger than the inside diameter of the pipe. Into the vertex of this wax cone force a phonograph needle,



To Make Small Castings Without Much Trouble Will Be Welcomed by Every Experimenter.

blunt end first, so that there is 1/4 inch of the point projecting from the wax. Then heat the cone around the edges and force it into one end of the pipe, with the vertex in (Fig. 1). The wax will harden and hold the cone in place.

From the open end of the pipe insert the wax model and stick it on the sharp point of the needle (Fig. 1). Procure some of the investment compound used by dentists in making gold inlays. Mix this with water until the mixture has the consistency of heavy cream. Take a small camel's-hair brush and paint the model with this. Then add a little more powder, so that the mixture thickens a trifle, but yet is not so thick that it will not run freely. Fill the pipe with the paste in this state (Fig. 1), and lay the whole on a wire screen far enough above the flame of a Bunsen burner so that the wax will not melt. Leave it for at least one hour, then lower it to a point about one inch above the flame. When the wax cone has melted and run out, pull out the phonograph needle with a pair of pliers, and let the melted wax of the model run out the hole left by the needle. Remove from the flame and invert. Pour the melted brass into the depression left by the cone, and it will run into the mould thru the needle hole. Allow it to cool, wash out the investment compound, and you will have a perfect reproduction in brass of the wax model.

Contributed by RODNEY H. GOTT.

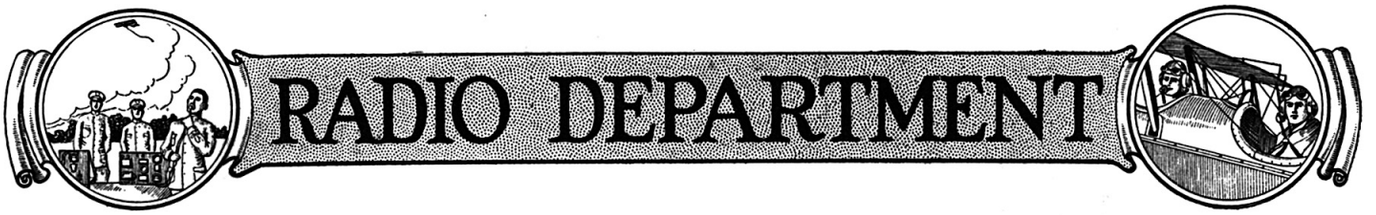
MAKING A FUSE.

Prepare a saturated solution of potassium nitrate by dissolving a considerable quantity of the salt in a cup of hot water. While still hot place in the solution a long cotton string and strips of porous paper, as blotting paper. When they have become saturated remove and allow to dry thoroughly. Ignite either the string or the paper and the combustion will be identical with that of a fuse.

Try one on the following mixture: mix equal quantities of magnesium dust and potassium nitrate powder and place in a heap on asbestos paper or a piece of tin plate. In the top of the heap insert one of the fuses and ignite. An intensely bright light results.

Powdered potassium chlorate is even better than the nitrate for this demonstration.

Contributed by FLOYD L. DARROW.



Carnarvon Radio Station

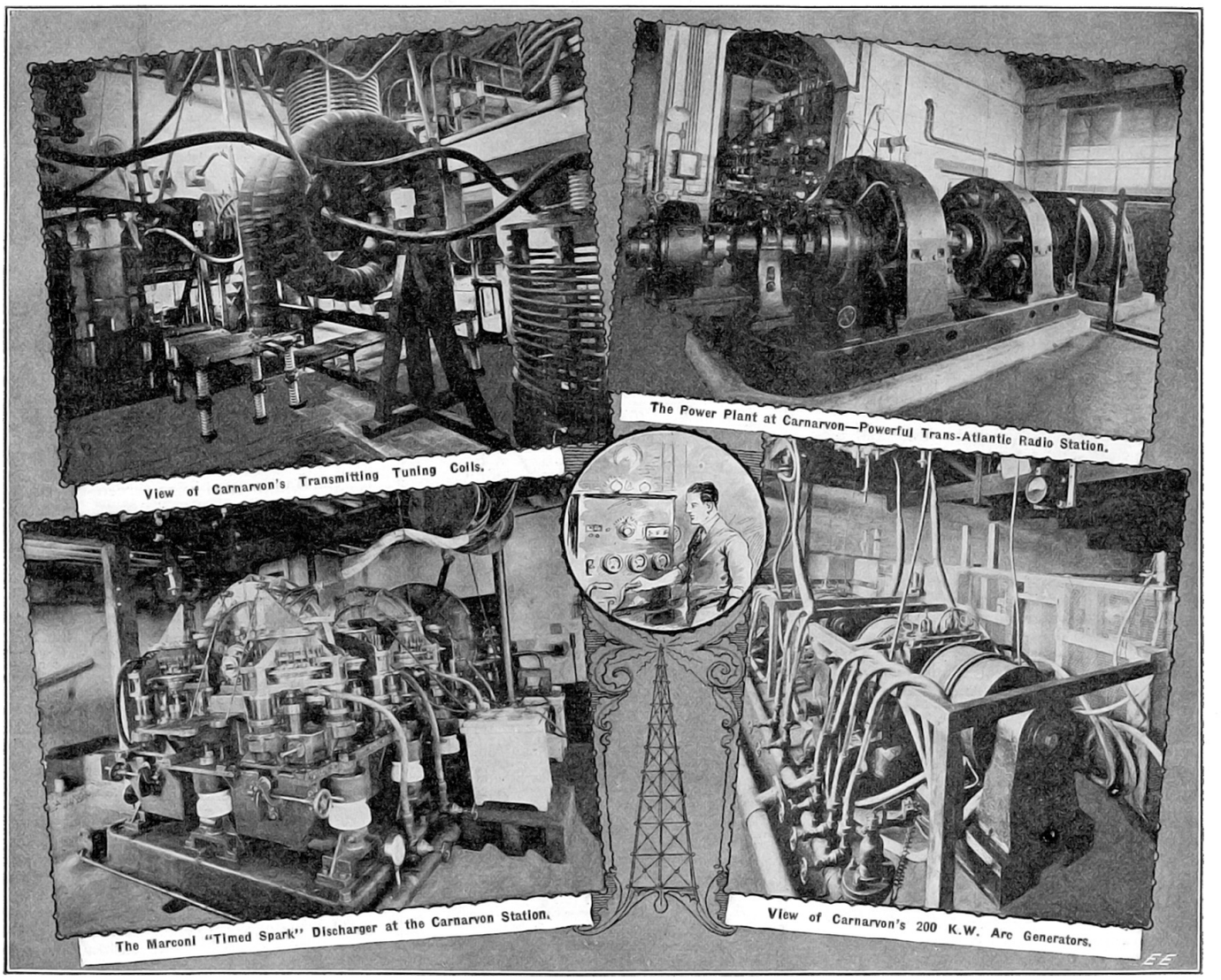
THE Carnarvon Wireless Station is situated at Ceunant, Llanrug, five miles from the historic town of Carnarvon. Built on the site of Cefn Du, 800 feet above the sea level, it commands a magnificent view of the Menai Straits, and on very clear days, of the Wicklow Hills. To the eastward, along the line of the aerial the ground rises about 1 in 10 to the top of the hill which is 1,450 feet high. The last set of masts supporting the aerial is 1,100 feet above the sea level and at this point a fine view of the Snowdon Range is seen, the Snowdon Peak being about six miles distant.

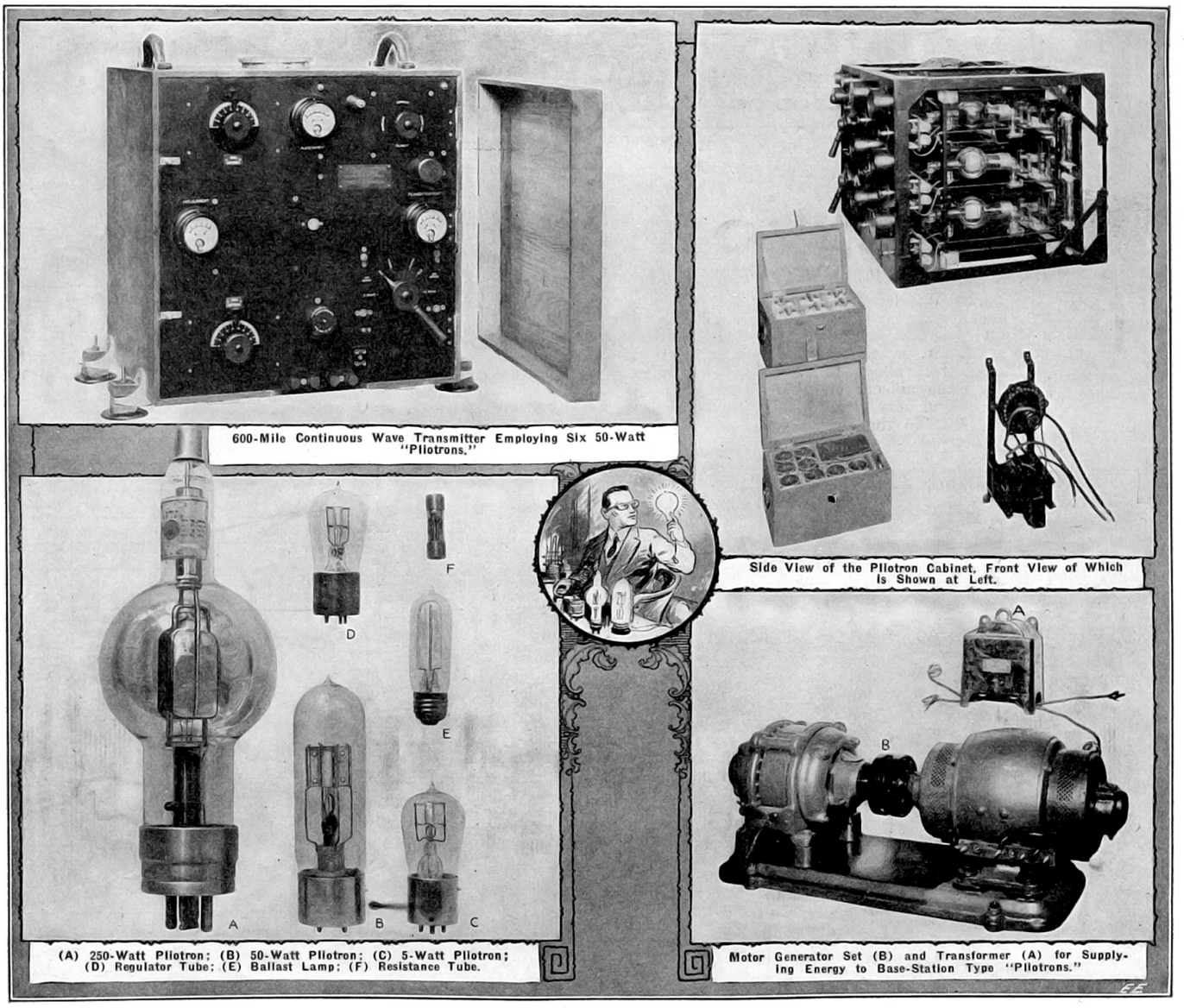
The aerial is of the Marconi directional type, so arranged that the maximum radiation is in the direction of New Brunswick, New Jersey, with which station commercial service will shortly be carried on. The wires, of which there are 20, are of 7/18 silicon-bronze, the breaking strain of which is 1,300 pounds. Each wire is 3,600 feet long and is separately hung by insulators from steel triatics supported by steel masts 400 feet high. There are 10 of these masts supporting the four triatics which have an average length of 500 feet, the distances between the triatics being 900 feet. Owing to the greater strain at the ends of the aerial three masts are provided to support the end triatics (which are split into two), two masts being provided for each of the inner triatics. The natural wave length of the aerial is 5,600 meters, and adjustable inductances to carry 300 amperes are provided for increasing this wave length to 14,000 meters. The effective capacity of the aerial at the latter wave length is .04 mfd and its resistance 2.1 ohms.

The electrical energy used for the wireless plant, heating and lighting, is obtained from the North Wales Power and Traction Co.'s Hydroelectric Station at Cwm-Dyli which is about two miles on the east side of Snowdon. It is of interest to note that here is one of the few places in the British Isles where we are able to use "white coal" or the natural energy of falling water, for this power station utilizes the waters of Llyn Llydaw which are led thru pipes to the water turbines 1,000 feet below the level of the lake. The turbines are direct coupled, the 3-phase alternators generating at 10,000 volts. Two aluminum power lines each of 500 k. w. capacity carry the current from the power station to the Marconi station, one being a line for the exclusive use of the latter, the other being the branch of a line supplying one of the slate quarries and used as a spare.

At the wireless station two 500 k.w.

(*Continued on page* 826)





600-Mile Continuous Wave Transmitter Employing Six 50-Watt "Pliotrons."

Side View of the Pliotron Cabinet. Front View of Which Is Shown at Left.

(A) 250-Watt Pliotron; (B) 50-Watt Pliotron; (C) 5-Watt Pliotron; (D) Regulator Tube; (E) Ballast Lamp; (F) Resistance Tube.

Motor Generator Set (B) and Transformer (A) for Supplying Energy to Base-Station Type "Pliotrons."

Modern American Radio Apparatus

AMERICA'S accomplishments in radio work both in the field of telegraphy and telephony were many and varied. One of the striking technical results of the war that will probably have far reaching peace-time results is the development of Transatlantic radio communication into an accurate and dependable system that can be counted on every day of the year and almost every hour of the day.

The demands that are now being made on this system of communication can be shown by the recently announced policy of the government to send all government department dispatches by radio to relieve the congested cables.

Now that the bar of secrecy has been lifted it is possible to announce that during the last year the greater part of the government's dispatches were transmitted by a new radio system developed by the General Electric Company. The company equipt the high powered radio station at New Brunswick, N. J., with its newly developed apparatus for Transatlantic telegraphy and telephony and placed it at the disposal of the government for official dispatches early in 1918, to meet the urgent demand for communication. The continuous and reliable service by this station has since been favorably commented on from distant parts of the world and has caused the government to place orders with this concern for two transmitting sets.

It is a matter of historic interest to record that it was the New Brunswick radio station that directed the first message to Germany after America's participation in the war. It will be remembered that it was in this message that President Wilson demanded the abdication of the Kaiser. That series of history-making messages which followed one another in such rapid succession and finally led to the speedy conclusion of the armistice were also sent from the New Brunswick station.

This new system of radio communication is known as the Alexanderson system and includes very marked improvements in all four stages which are common in all radio systems. These stages are, first, the generation of high frequency electric oscillations; second, the modulation of these oscillations into the dots and dashes of the telegraph code, or into the modulation of the human voice; third, the radiation of these electric oscillations in the form of waves, which travel with the velocity of light over the surface of the earth, and the fourth stage is the reception or detection of these waves by suitable instruments.

(*Continued on page* 828)

In December Radio News

Underground Radio for the Amateur. By E. T. Jones.
The Construction of Vacuum Tubes. By R. S. Hawkins.
German Radio War Instruments.
The Priess Loop Set. By Walter J. Henry.
Amateur Ethics. By Pierre H. Boucheron.
Primary Batteries for Audion Filaments. By R. H. Langley.
Describing Some Foreign Apparatus. By Fred M. Gill.
A Wavemeter of New Design. By W. S. Heppner.
A Triple Coil Receiving Transformer. By H. E. Parsons.
Junior Radio Section.

Calculation of Tree Wavelengths

By A. N. Tenna, V. T., Q. R. S., H. F., K. W., A. C.

Proprietor of Tony's Fruit Stand

NOW you see it's all plain, Jim, just take your wavemeter and set it right under this oak tree and have your buzzer to excite the tree and —zingo—"The Wavelength." Of course, great errors occur in the wavemeter method, so I have devised a method of calculating mathematically the wavelength of trees, bushes, acres of trees, etc.

I have found also, that trees with fruit have a greater capacity than those without, and rosebushes without roses have greater resistance and less capacity—of course, this is all clear when you take into consideration the fact that trees with half the leaves dead (in the month of October) have less capacity. From this we see that the leaves length of any tree depends upon the season. For instance, a tree in June was found to have a wavelength of 650 meters, while in October only 450 meters and the same tree in December but 150 meters. Therefore you will have to have an automatic wavelength changing device inside your station to add inductance in the loading coil according to the changes in the thermometer.

Wavelength of Pear Tree.

A tree with 6,000,687,564,765,543,409 leaves and 72 large branches, 64 medium sized branches and 20 very thin branches had a wavelength of 750 meters. Now this same tree with four large branches chopped off gave a reading of 690—a recount of the leaves gave us—6,000,687,564,235,001,202 leaves. The counting of the leaves of course was the smallest part of the work. (Naturally) The formula for calculating the wavelength of a pear tree and found to jibe with the wavemeter readings, is:

$$\text{W. L. equals} \frac{H \times NL. \times NF.}{\text{Number of branches.}}$$

Where: H—Average height.
NL—Actual number of leaves.
and NP—Number of pears on the tree.

This has been found to vary with the season; for instance, this same tree without leaves or fruit with the same number of branches and height will naturally give you a lower wavelength as is evident from the above formula. In other words, the wavelengths fall off as the leaves and fruit fall. Simple eh?

Some people think this Tree Wireless is a joke; well, if they want to find it out just begin counting the leaves on any tree —and they will be convinced—that it's no joke.

Capacity of Same Pear Tree.

The formula for the capacity of the tree is as follows:

$$\text{Capacity equals} \frac{\text{Wavelength found from above.}}{(tl \times NL) \times (\text{area of } P \times NP) - H}$$

Where; tl—Thickness of the leaves.
NL—Total number of leaves.
P—Pears.
NP—Number of pears and H the height of tree.

Below is given a graph of the wavelength of trees for the various seasons—this is for pear trees 35 feet high.

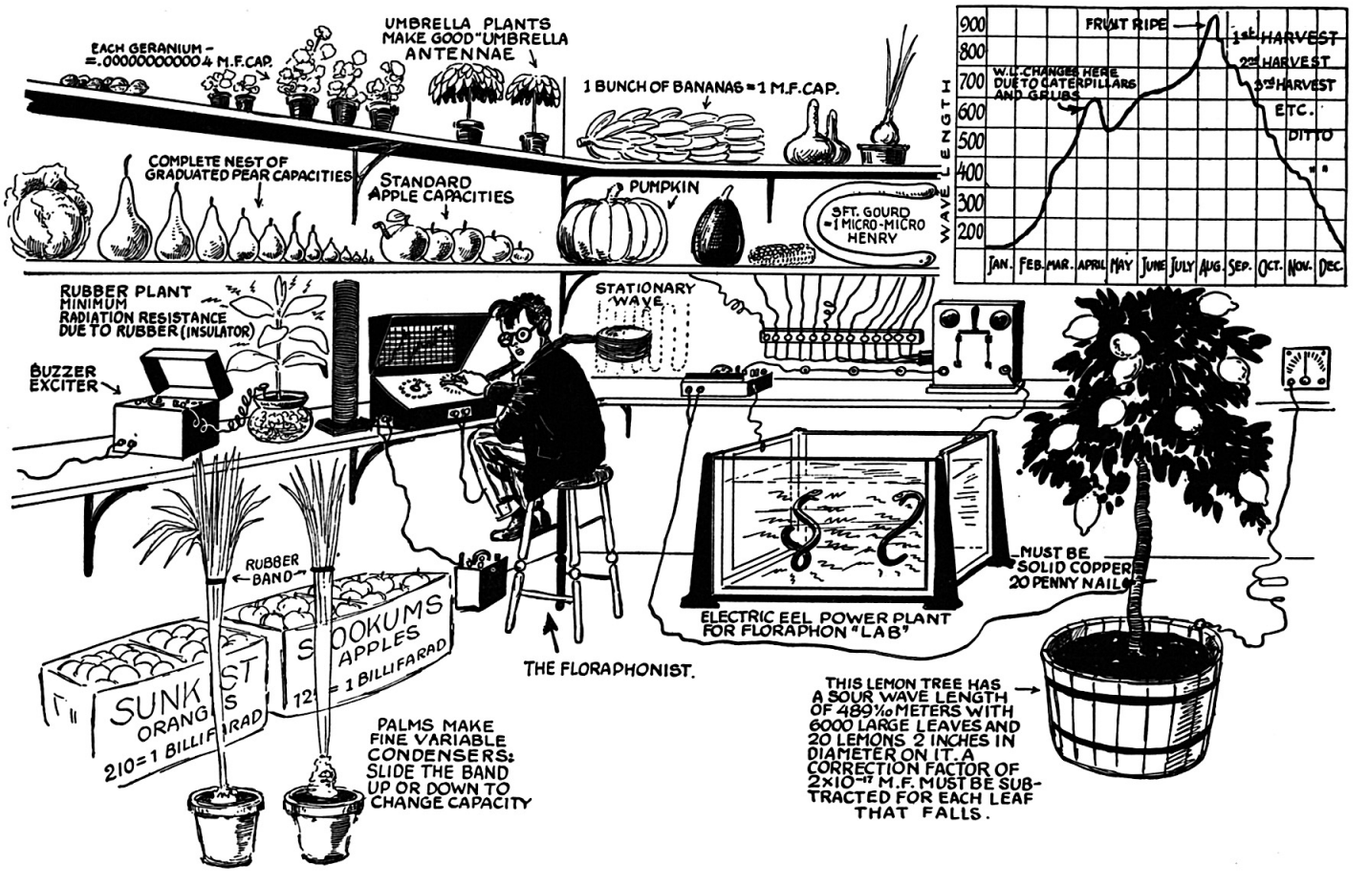
H. F. Resistance of The Tree

About the most suitable formula devised for the calculation of high frequency resistance of tree antennae is as follows:

$$\text{H.F.R. equals} \frac{drLB \times drMB \times drSB \div dr \text{ of trunk of tree}}{\text{resistance of one leaf} \times NL} \times NP.$$

Where; dr—Direct resistance.
drLB—Direct resistance of large branches.
drMB—Direct resistance of medium size branches.
drSB—Direct resistance of small branches.
NL—Number of leaves.
NP—Number of pears.

(Translated from the Hertzian Wave Nut-book by E. T. Jones.)



Well, Papa Squier Started Something When He Wished This "Tree Wireless" on Us. Here Is a Typical View of a Young and Enthusiastic "Floraphonist" Busily Engaged in His Frost-Proof "Lab.," Doping Out the Natural Wavelength of a Healthy Rubber Plant. It's a Man's-Size Job to Calculate the Wavelength of a Tree, Especially on a Windy Day, When the Leaves and Fruit May Be Blown off in Considerable Numbers. Each Leaf and Pear or Apple Can Be Compensated for in the Calculations, However, Once the Micro-Farad Capacity and Micro-Micro Henry Inductance, Values for Each Are Determined and Known. If Anyone Can Successfully Compute the Wavelength of a Healthy Young Pear or Plum Tree in Full Fruitage, He Should Certainly Be Awarded the "Nobel" Prize in Physics—We Said It,—"If" He Can Do It. We'll Wager He Will Need a Dozen "Einsteins" Before He's Thru. And Then the Wind Comes Along and Spoils All the Calculations. Gads, Tho!!!

Radio Guides Ships Thru Fog

"YOUR naval communication service, especially in its radio compass stations and their activities, is a great institution and a distinct boon to seamen. It ought to be maintained permanently," said Captain W. F. Wood, D.S.C., master of the steamship *Lancastrian* of the Leland line, recently, as he described what the U. S. Naval radio-compass service had done for him on his latest entry into New York Harbor. Consulting his log from time to time for the sake of accuracy, Captain Wood said:

"We were bound in from Antwerp to New York on the afternoon of October 3rd and had expected to make the Nantucket lightship by six o'clock. At 5:50, however, we ran into a dense fog. I slowed the engines to half speed and kept heaving the lead, which registered from thirty-six to twenty-five fathoms. We got the latter sounding at eight o'clock. This gave me a good line of soundings to compare with the chart, but we could not yet hear the foghorn aboard the lightship. At about half-past seven o'clock I had the radio officer sound our signal and call up the radio-compass station on Fire Island, the signal letters for which are N. A. H. The message we sent by wireless to Fire Island read:—'What is my true bearing?' It was signed, 'Wood, Master.'"

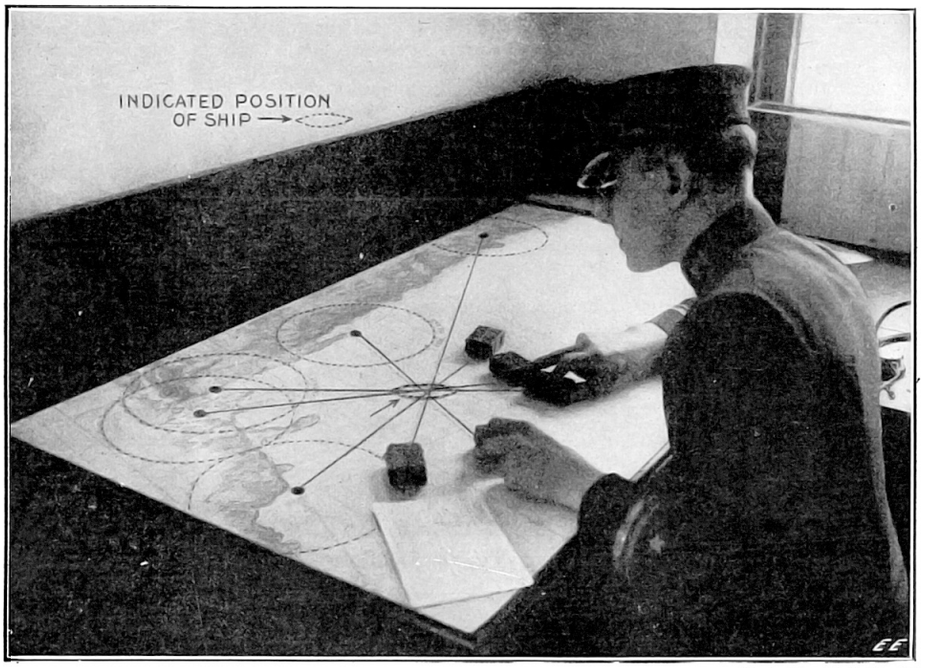


Photo New York Herald

Sandy Hook Got Captain Wood's Appeal at a Distance of Sixty Miles. Mantoloking Was Even Further Away. These Stations and Also That at Fire Island, by Their Land Lines Into New York, Reported the Bearings of the Lancastrian From Their Respective Positions. The Central Station, Within Ten Minutes Then Sent All Three Bearings by Radio to the Leland Line Ship and Her Master's Mind Was at Ease.

RADIO COMPASS LOCATION GIVEN IN TEN MINUTES.

"I was standing in the radio room at the time, looking over the shoulder of the operator, who kept sounding our letter code signal on his transmitter. Within ten minutes after we had asked for our true bearing from Fire Island the following reply came crackling back to us:—

"'Your true bearing at 7:39 P. M., from Fire Island, 109 degrees; Sandy Hook, 87; Mantoloking, 65.'

"This radiogram was dated from the *central compass control station* of the Naval Communication Service, at No. 44 Whitehall street, New York. When I wrote my message of inquiry and handed it to our Marconi operator I handed him along with it a slip of paper on which I had written my own estimate, by dead reckoning, of our position at that time. I had figured it to be a bearing of 108 degrees from Fire Island. When, as I looked over the shoulder of the receiving operator, I saw him write down, 'From Fire Island, 109,' I was pleased that I had estimated our position within one degree.

"Imagine my delight and surprise when, right on the heels of this bearing, came the additional readings for our direction from Sandy Hook and also from Mantoloking, N. J. It was then a matter of only a few moments to project these three lines upon the chart, and the point at which they *intersected* was, of course, our precise position at 7:39 P. M.

"So we carried on then with entire confidence, tho the fog continued dense. At ten o'clock I hauled my course to the northward and at 10:40 o'clock the fog lifted and revealed the Fire Island light abeam, exactly where it ought to be to prove the precisely accurate information flashed to us out there in the murk three hours earlier from the central compass control station in New York City.

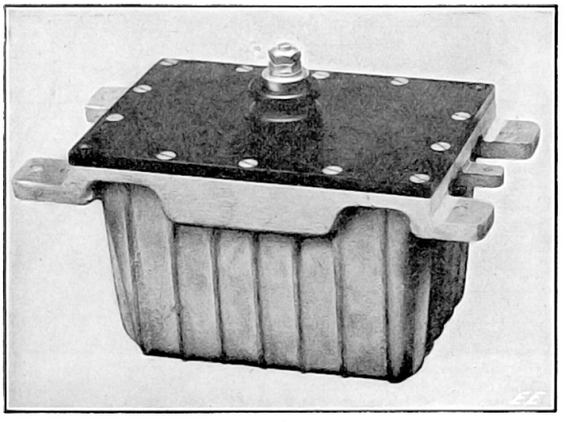
"There is not the slightest doubt of the inestimable value of these radio position finders. We have nothing of the sort installed as yet in England, but I hope we soon shall have them. The Admiralty, however, has instructed all masters concerning their use on this side and has emphasized their value."

Thus does the field of the "Radio Compass" expand daily almost.

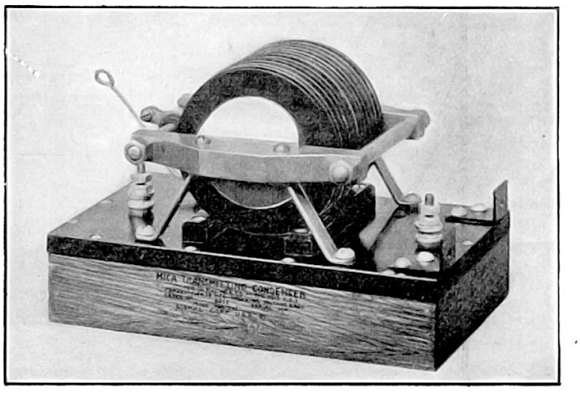
Mica Condensers for Radio Sets

A new mica condenser for radio equipments is now being made which the manufacturer states is in use by the United States and Allied Governments and many of the large companies manufacturing radio apparatus. The maker calls attention to the fact that since its invention in 1745 the Leyden jar has been used in practically its original style, without any radical improvements or changes. Practically every radio equipment is used to its capacity, and up to the time this new mica insulated condenser was invented Leyden jars were used especially for high potentials. When in operation the radio apparatus thus equipt was not safe and reliable, as the Leyden jar would crack and break down after a continued use for an hour or so making the apparatus inoperative.

Wherever metal containers are not suitable the condensers can be mounted in wooden or other insulating boxes, or the metal case can be insulated from the condenser itself and the condenser terminals mounted independently on two insulated posts.



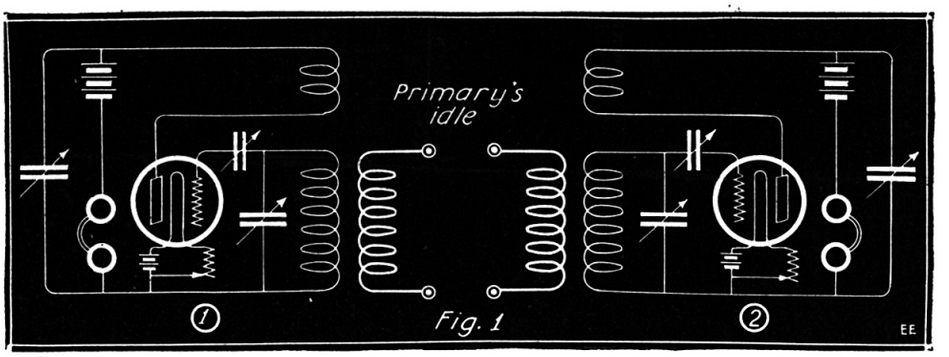
A New Mica Condenser for Radio Equipments Which the Maker States It Is Practically Impossible to Break Down Even When Used for High Potentials.



"Locating Submarines by Audion Syphoning"

By Edward T. Jones, A.M.I.R.E.

PRACTICALLY every one familiar with the present day types of audion circuits employing the feed back systems realizes the fact that if two such receivers in close proximity are tuned to the same wavelength "syphon-effects" of considerable magnitude are produced, and the oscillations emitted by one tube are picked up by the other receiver and vice versa.



Two Audion Receiving Sets Arranged Some Distance Apart Have, Under Actual Tests By the Author, Shown That When Both Are Tuned to the Same Wave Length, That Station No. 1 Can Hear the Note of the Oscillating Audion At Station No. 2, and Vice Versa. This Effect is Termed "Syphoning".

Recently, the H-2 (U. S. submarine) successfully demonstrated the ability of underwater craft to transmit and receive while submerged. The H-2 submerged and communicated with airplanes and vessels of the fleet. This naturally proves that during wartime a submarine can easily keep in touch with the ships and shore stations, and receive its radio compass locations at various intervals. However, it is to be expected that this system will come into general use on all the submarines of the foreign Navies, and that during wartime they will endeavor to exercise the use of such a system freely. We may then consider an enemy submarine as having submerged after having sighted its adversary; it then naturally maintains silence in respect to its transmitting apparatus, and continues to listen in for what the destroyers and other vessels may have to say. The fact is, that the vessel while endeavoring to maintain silence is defeating its own endeavors, for while listening in, the receiving bulb is actually *transmitting*, and if any of the destroyers tune their receiving apparatus to the same setting which the submarine is listening in on there will result the syphoning effect described previously. Should the destroyer be equipt with a direction finding apparatus it can without any difficulty run down this undersea craft without the latter knowing what is happening. This is only one of the many uses this previously dubbed nuisance can be put to.

POSSIBILITIES OF LOCAL COMMERCIAL STATION SYPHONING AMATEURS.

Since the general use of audions and their associated circuits was adopted, it has been heard from numerous sources that Amateurs who have copied a certain station one night could not receive this same station the following night. This further lends aid to my beliefs and as the reader shall understand from what follows, it was due to the fact that *the "Large Commercial Station" in that particular vicinity was syphoning the smaller stations* and the following night the effect was not present because the "Controlling" station was not listening on that same wavelength and no syphon effect took place; naturally the short range of the smaller Amateur installation did not permit it to copy signals from the extraordinary distances recorded the night previous. In figure 1 two receiving sets of the feedback type are shown and are separated in this instance fifty feet apart. Both sets are tuned to the same wavelength (say 1000 meters) and the two sets are then in resonance. Number One can hear the true clear note of the oscillating audion at station Two, and vice versa; this is caused by the receiver also acting as a transmitter and if a key is arranged in the circuit to vary either the inductance or capacity, intelligent signals can be transmitted between the two. This effect has been termed "syphoning" and is very pronounced at stations where the receiving apparatus are very near to each other.

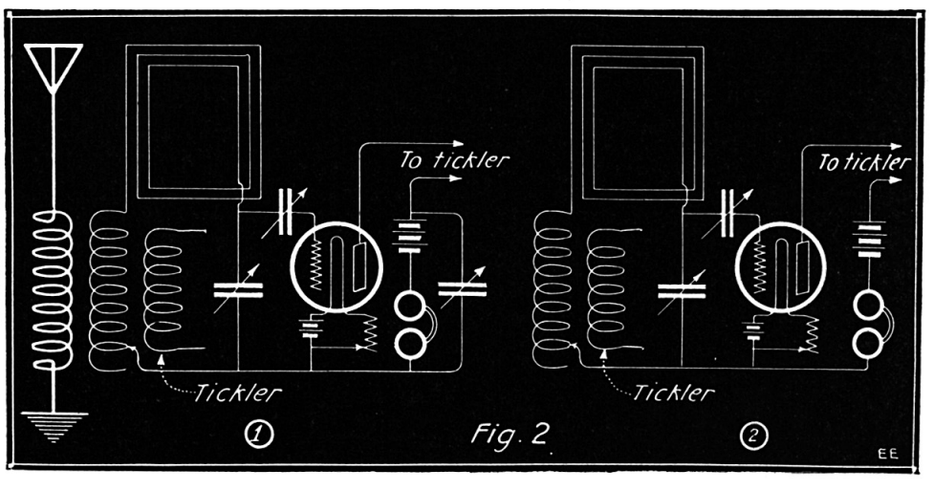
I have personally carried out experiments at distances up to two thousand yards and with suitable receiving apparatus informed the receiving operator the correct wavelength he was listening in on. Of course, as mentioned before, this depended upon the receiving operator having his bulb oscillating, and likewise my own, in order to pick up the undamped oscillations being emitted by his receiving apparatus.

Furthermore, I have, without an antenna connected to my receiver and same maintained in a state of oscillation, been syphoned by a large receiving station, when I was located some five hundred feet from the antenna and receiving apparatus. Now the MAIN FEATURE OF THIS PARTICULAR INCIDENT IS THAT THE SYPHONING EFFECT (WAVE) ACTED AS THE CARRIER OF THE SIGNALS BEING RECEIVED FROM THE OVERHEAD ANTENNA CONNECTED TO THE RECEIVING STATION SOME FIVE HUNDRED FEET FROM ME. This prompts me to believe that many of the Amateurs in and about a city where there is a large Commercial or Naval plant should not put too much faith in their own receiving apparatus in respect to the remarkable distances covered with the same; for it may be that they are being syphoned by the local station which has the apparatus to easily cover the distance.

Another fact which I may mention here is that, when a station is in the act of syphoning another, it tends to reduce the strength of signals received at that station, and tends to rob it of some of the signal's strength. It may be that the total is proportionately divided between the two, three or four, whichever may be the case.

ELIMINATION OF STATIC BY SYPHON METHOD.

I have also found thru my extensive experiments and investigations into the possibilities of this phenomena that when syphon waves act as the carrier of signals from the main receiver to another receiver installed some several hundred feet away, the static which is so pronounced in the first instance is hardly perceptible at the second receiving apparatus, although the signals have not undergone a great degree of weakening. It is my contention, that if a receiver, say number one in figure 2 had a coil of fairly large dimensions inserted in the secondary circuit so that this syphon wave could be directed to one certain point (where the second receiving apparatus is installed) that a maximum of the signal would be received there, in a greater proportion than the static. While I have no good theory to offer at present for this statement, it has proven so in actual tests and therefore there does not seem to be very much need for lengthy explanations.



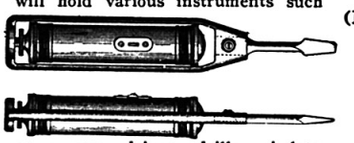
"Static" Is Reduced When the Signals are "Syphoned" from the Main Receiving Station to a Second Receiving Set, Says the Author. He Suggests the Use of Two Loop Aerials as Shown, to Transfer the Energy to the Second Receptor.

LATEST PATENTS

Illuminative Tool.

(No. 1,309,363, issued to Edward J. Meinke.)

We have seen illuminative pens and pencils, now comes the illuminative tool. This patent, recently granted, consists of a device which will hold various instruments such

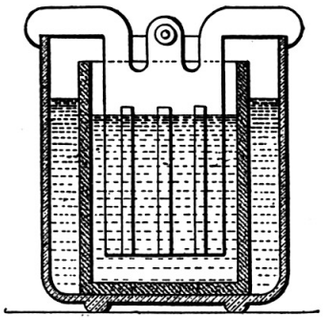


as a screw-driver, drills, gimlets, augers, chisels and the like, in the form of a handle or a frame, so that any well-known standard electric flashlight can be mounted therein. Hammering on the frame will not injure the flashlight, which can be removed if necessary, and a new battery inserted.

Primary Electric Cell.

(No. 1,310,695, issued to Harry E. Evans.)

Generally, in primary electric cells employing two fluids, the electrolyte and depolarizing fluid, a porous cap was heretofore necessary in order to separate the two liquids or else the gravity method had to be used. In this idea, however, a new use is given to the carbon inasmuch as it acts not only as the positive pole of the battery, but also as the porous cup separating the electrolyte placed within its recess, from the depolarizer outside. The zinc being suspended in the carbon cup. In this manner the cell is not only simplified, but cheapened, and the internal resist-

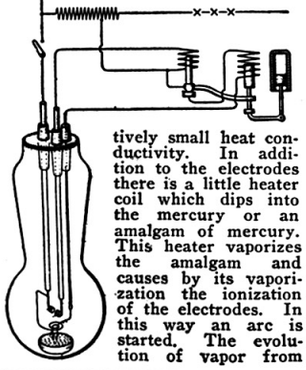


ance caused by porous cups in the past is greatly reduced.

Enclosed Electric Arc.

(No. 1,310,067, issued to Philip K. Devers, Jr.)

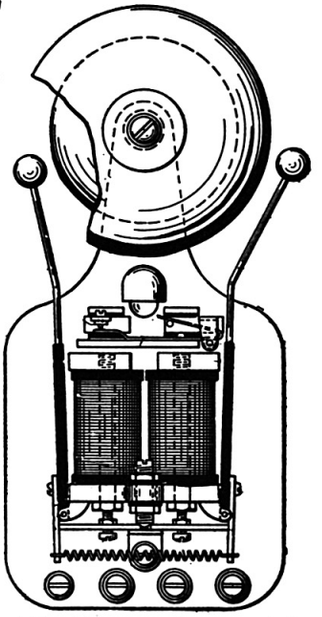
This relates to enclosed arc lamps in which an arc is operated between electrodes of refractory materials. The entire arc is enclosed in a chamber which has a constriction in its center and is filled with a gas at a pressure slightly above atmospheric. The gas contained within the globe has rela-



tively small heat conductivity. In addition to the electrodes there is a little heater coil which dips into the mercury or an amalgam of mercury. This heater vaporizes the amalgam and causes by its vaporization the ionization of the electrodes. In this way an arc is started. The evolution of vapor from the mercury or amalgam displaces the nitrogen or other gas into the upper chamber, and hence increases the efficiency of the lamp by supplying an atmosphere of vapor between the electrodes.

Novel Electric Bell.

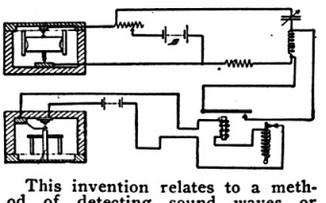
(No. 1,310,813, issued to Albert M. Ward.)



This idea comprises two bells, one over the other, with respective hammers to operate either of them. Each hammer may be attracted when an outside circuit is closed, energizing one of the coils. The make-and-break in this case is at the lower end of the bell in the form of a set screw. A winding is placed on both cores in such a manner that the third circuit in the form of a buzzer may likewise be operated. Inasmuch as this third circuit is of a much higher frequency than that at which the bells can operate, no noticeable effect is perceived, and the hammers do not actuate, altho the buzzer vibrates and the cores themselves are energized.

Acoustic Actuating Mechanism.

(No. 1,310,568, issued to A. C. Heap and O. B. Field.)

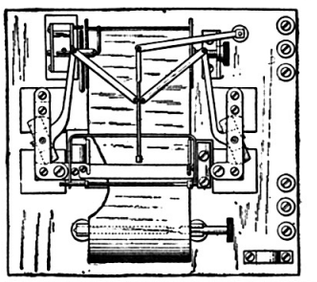


This invention relates to a method of detecting sound waves or pulses transmitted thru water and is attached to the surface of an under water mine, or submerged body, and either serves to operate a signaling device or cause the mine to explode. It only operates when it receives sound waves or impulses of a certain strength, and according to its inventors does not go off even if heavy explosive charges are detonated in its vicinity. A "dancing contact" is used, which responds to the sound waves, the entire case being filled with some liquid, such as oil. When sound waves of a certain pitch are received, the resistance between the electrodes varies, and the potential difference at the terminals of the condenser is varied, thus allowing a pulsating current to pass thru the device.

Telautographic Apparatus.

(No. 1,312,596, issued to George S. Tiffany.)

With this telautograph apparatus writing movements of the receiving pen are kept in unison with

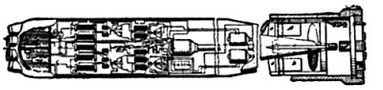


the transmitting tracer under which there is a system of tracer lines, affected by the movements of the sending pen. In this way, more or less, current is allowed to pass, and the movements of the receiving pen are affected by the magnetic coils, which are excited to a variable extent during the transmitting operation.

Sound Controlled Dirigible Torpedo.

(No. 1,312,510, issued to George Baker.)

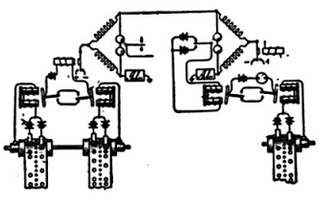
This invention seems very plausible. It consists of a torpedo which is discharged from a torpedo tube automatically; when it reaches the vicinity of some enemy craft the propelling mechanism is set into motion. The torpedo on becoming active, guides itself directly towards the enemy ship, due to the sound waves set up by the vessel. A plurality of microphones are arranged to the various circuits, so that when the sound, which comes in stronger at one microphone than at another, will affect the steering rudder in such manner until both sounds are of same intensity. The elevating rudder is likewise controlled in similar manner.



Secret Signaling System.

(No. 1,312,574, issued to Ralph E. Pierce.)

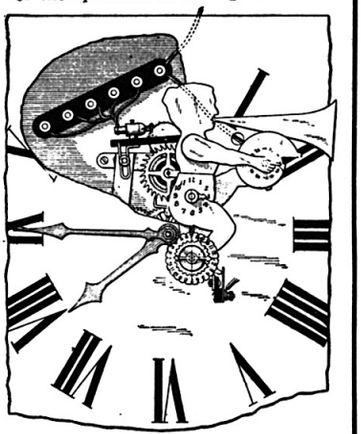
Many patents have been issued which have attempted to send secret messages by alternating or breaking up the current impulses into unintelligible signals by means of ciphering switches, all of which have some good and some bad features. A device which promises to become very popular is this one granted recently. It implies two systems of tapes which are run on a drum, the said tapes being perforated so that extra impulses may be sent, and the regular dashes or dots broken up by the action of relays operated by the tapes. At the receiving end another tape travels thru a like apparatus causing some signals to be inserted and others removed from the original message as transmitted over the line, as can easily be noted in the accompanying diagram. In this way, absolute secrecy is obtained by use of the key for ciphering and deciphering. Synchronizing devices are employed to control the speed of these keys.



An Automatic Sign.

(No. 1,313,757, issued to Samuel C. Swindler.)

This patent consists of a figure carrying a relatively stationary leg, a pivoted leg and a pivot body and is arranged in front of a dial. The pivoted body swings backward and forward during vertical movement of the plate. There is a spiral cam rotatively mounted between the arms carried by the body and which is provided with numerals, so that it may be moved under the indicating finger. In this manner the operator can regulate the duration of the operation of the sign or other

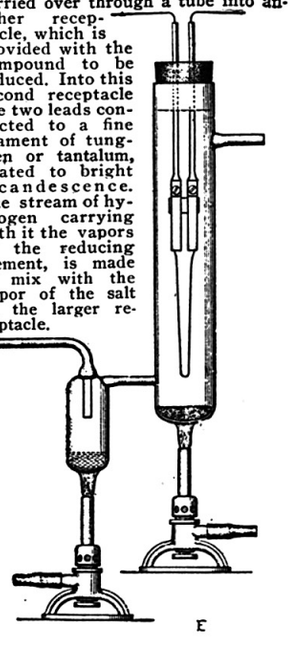


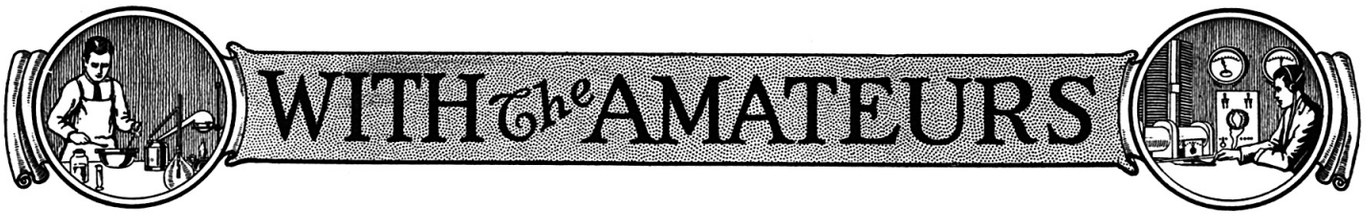
electric device controlled by the five or more circuits. For controlling another set of lamps another dial is pivoted on the body and still another at the foot. In this way a plurality of electric circuits may be operated.

Producing Pure Elements.

(No. 1,306,568, issued to Ezechiel Weintraub.)

This invention relates to a method of isolation of difficultly reducible elements, such as uranium, which were always very difficult to reduce. The reducing metal (sodium) is contained within a smaller receptacle, and it is heated and purified by a stream of hydrogen which enters at the inlet. When it is vaporized it is carried over through a tube into another receptacle, which is provided with the compound to be reduced. Into this second receptacle are two leads connected to a fine filament of tungsten or tantalum, heated to bright incandescence. The stream of hydrogen carrying with it the vapors of the reducing element, is made to mix with the vapor of the salt in the larger receptacle.





Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

The Editors desire to call to the attention of all owners of "Electrical and Chemical Laboratories" the fact that hereafter the MONTHLY PRIZE WILL BE $5.00 CASH, instead of $3.00. ALSO $2.00 CASH WILL BE PAID TO EACH "HONORABLE MENTION" ENTRY PUBLISHT. We have not received any "Laboratory Photographs" of late. So "go to it" and send us your photo, together with that of your laboratory. If they are particularly good we may list some new and bigger prizes. So get busy, Boys!!! It's up to you. Here's a way to earn some greatly wanted laboratory apparatus at no cost whatever. Don't be afraid to send in too many photos, Boys.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $5.00 PRIZE WINNER— CHARLES AMBROSE YOCUM

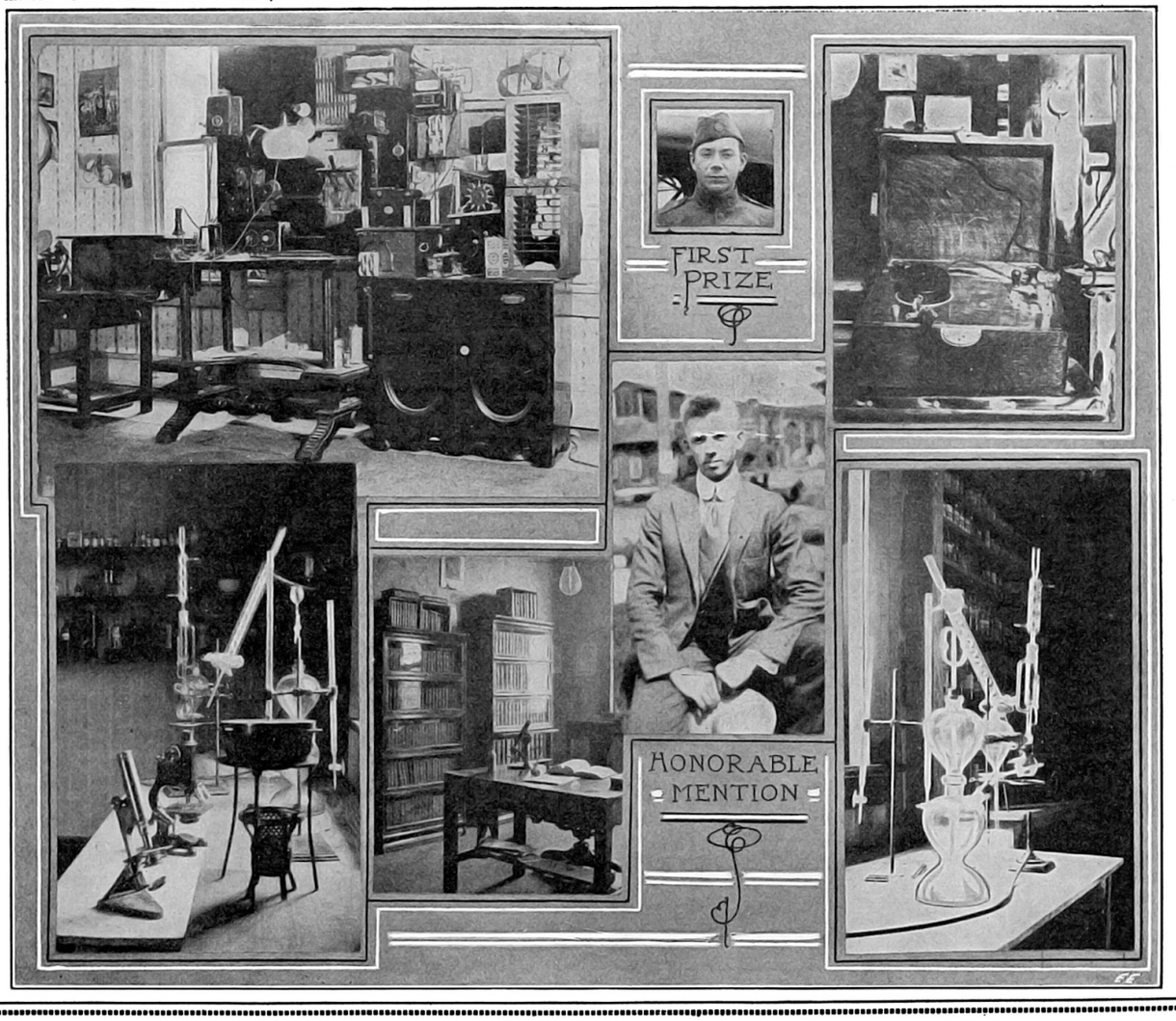
HEREWITH are a few photographs of my "Electrical Laboratory." I have a one-half kilowatt step-up transformer, a Tesla coil giving a six-inch spark, a one-inch spark coil, a water-power motor running a generator, a few small motors, rotary gap, 18" by 8" loading coil with 36 taps, step-down transformer, Brandes head set, 20 plate glass sending condenser, two mineral detectors, loose coupler of the navy style, telephone transmitter on swinging arm (in the middle of the switch-board), used for a speaking arc, which is also used on my telephone by utilizing a double-throw switch. I have electric meters, so I can always know how much power the apparatus consumes. There are two antennae, one 200-foot, two-wire, used for receiving, and one four-wire, 120 feet long for sending. I also possess a carbon rheostat, Murdock oscillation transformer, Murdock wireless key, with a shunt device under key, which shorts the detector when the key is pressed.

I have a good range in sending and with an Audion can receive about 2000 to 3000 miles. On top of the step-up transformer is seen a small box; it contains a small receiving and sending apparatus capable of transmitting one-half mile and receiving ten miles.—Charles Ambrose Yocum, 438 Fairview St., Pottsville, Pa.

HONORABLE MENTION—B. O. SHIFLETT—$2.00 PRIZE PAID EACH "HONORABLE MENTION"

MY "laboratory" is in a large, well-aired, spacious room on the second floor on a corner facing northeast and southeast. While it is equipt chiefly for chemical and microscopical work, yet it has five electric light connections or sockets for 110-volt A-C. There are numerous pieces of electrical apparatus, such as induction coils, telegraph apparatus, small motors, transformers, static devices, etc. I have spent a great deal of my time in the study of phonographs, cameras, telescopes and microscopes—trying to make improvements on phonographic devices; and in the field of lenses, making adaptations of different forms to certain kinds of conditions, such as the projection of "microphotographs" and "microphotography." One of the pictures shows one corner, in which is a lavatory, to the right of which is a work table, covered with some equipment set-up, burettes, Leibig still, Soxhlet extractor, Kipp's gas generator, separatory funnel, water-bath, Bunsen burner and alcohol lamp and two high-powered microscopes. The other photos show one end of the chemical cabinet, the top of which contains shelves filled with chemicals and reagents, the bottom being filled with apparatus.

I have been reading the ELECTRICAL EXPERIMENTER ever since it first began.—B. O. Shiflett, 138 So. 55th St., Birmingham, Ala.



Science in Slang

By EMERSON EASTERLING

"IN the Fritzey again!" howled the chauffeur.

The benzine go-cart had just exhibited its muline instincts — or tendency toward inertia as far as locomotation was concerned.

The azurely, effluviated auto-engineer wandered into the depths of the unknown that lies beneath the hood and Punk turned to Jazz with:

"Say, Stazz Jokes, will you be so kind as to bust loose and put us ignorant honyots wise to the hidden mystery that most everyone knows about—but I don't——that makes the buses commence up the street without the herder pouncing out and doing the Henry Ford at the bow end of the land craft? I know how to jump on the self-beginner and how to keep the gas operated thumper rattling, after I do the fatal stunt —but what I crave is the *why* and the *wherefore*—dost thou getteth me, Sir Lunchalot?"

"The person spoken to doth," returned Jazz.

The story then runs something like this

"Once upon a time—in the first gray days of modern mechanical history, a boob sat at a pile of junk—we'll not give the guy away— waxing sore and emitting moisture under the hat. Ye olde inventor was working on a conglomeration of metal that was to furnish power by the expansion, or rather the concussion or pressure exerted from a series of explosions that were to take place in an enclosed chamber. But the question was to make the explosions in a true classical manner.

Juicing the Jazz Wagon

"Some score of bewildered brothers in the game had tried many means of bringing the probability into an honest possibility. But our hero—"

"You mean villian!" This from the besmeared driver who was—you know—up fore.

"But our ———," continued Stokes, "was working on another wise hunch. His graft was to harness the Goddess Electra along with the God. . . . (Editor, please insert here the name of some political enem . The writer is no political authority. Besides we might not agree. I'll take the blame of your choice—if blame falls. Enclosed in parenthesis is *not* intended for print.)"

"(Political enemy)?" wondered—out loud —Mr. Vote, our artist friend from Portland, "Why do you use him for some contribution God? What is he supposed to be god of?"

"Gas—along with hot air," smiled back Stokes.

"As I was about to say," Stokes went on, "our what-you-may-call-him, as he sat dripping over the model of his brain baby, thinking and sweating, doped out the spark ignition for gas engines. Before that the bums on the works had been using flint lock contraptions, flame, and everything.

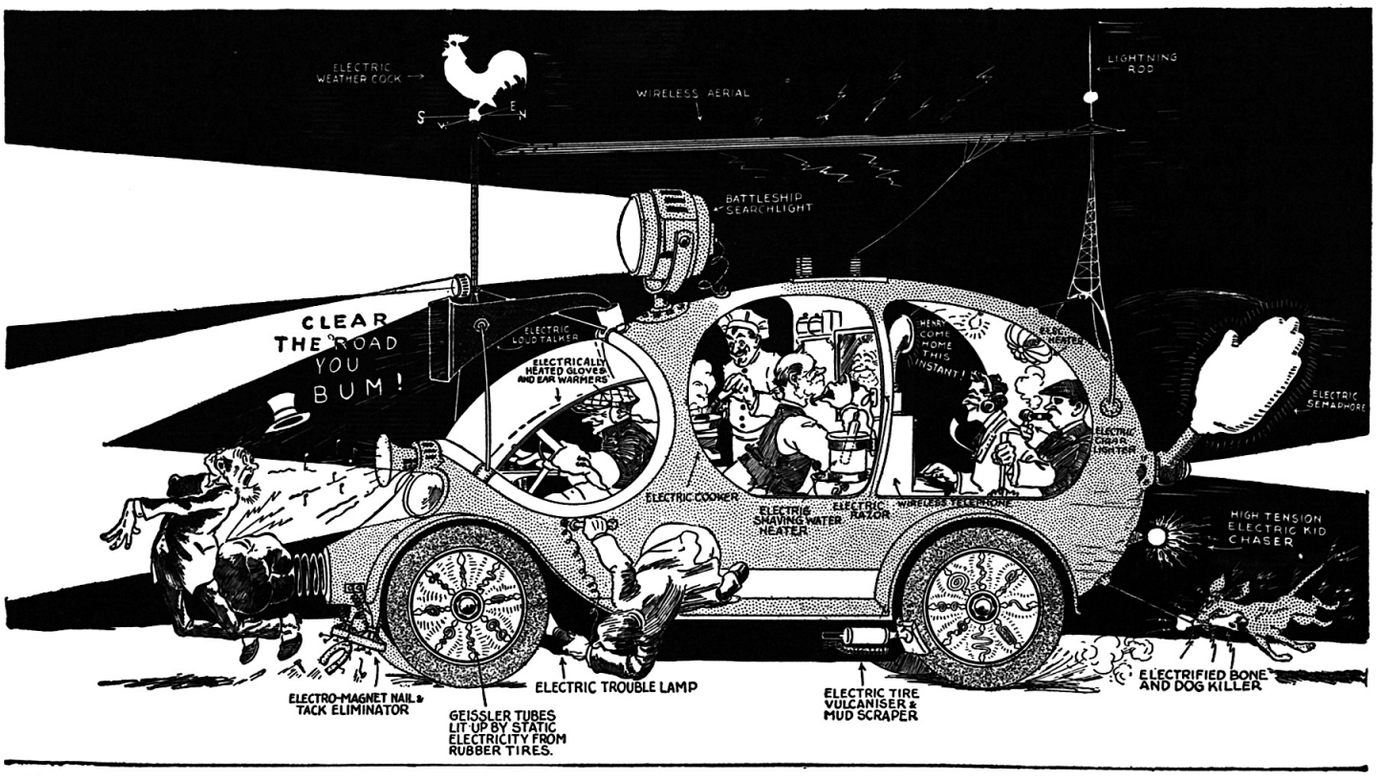
"The spark stunt proved to be *the* thing in the game. As time shapened out the ends —like Shakie averred divinity would do —spark plugs came into existence. If you care to see how far the inventors have wandered in the field, just meander into a spark plug emporium and gaze over the assortment. Every one is claimed to be a little better in some way or other for some purpose or other than the rest.

"Some manufacturers are not satisfied with one spark plug and jab in a couple—this is in the larger types of stationary engines. For the automobile engines *one* is a-plenty—at least *at a time.*

"To get down to the information of the situation: The thing is run like this: A source of juice, say a bank of batteries—a battery to be explicit, furnishes the V plus A for the induction—or spark—coil. The voltage—that's the capital V—up to a point where it is not hampered by a short air or gas gap, flashes right across and ignites the inflammable mixture in the cylinder chamber and does the same thing in a mechanical way that a lot of similar things do in a political way.

"Of course, the guy that uses the engine don't want the spark shooting across the gap steady, or at random, so the makers have devised all sorts of do-funny things they call timers and—you know, those cute lil trade names. All serve the same purpose—that of making the necessary arrangements to have the spark blaze away at the psychological, or rather the physiological moment. The revolving of the revolving parts of the motor cause the circuit to be opened and closed. As the engine speeds up it is more efficient to have the ignition take place a fraction of a second sooner than in the case of slow running or hard pulling. For this purpose there is installed on most cars the spark advance, or adjuster, with which we are all familiar.

(*Continued on page* 798)



If Your Flivver Has a Well Stocked Juice-Box Don't Be Bashful—But Go the Limit. This Being the Electrical Age—or Rage—Let's All Be Comfy. Take a Squint At the Above Portrait, But Don't Crack Your Lip Laughing. The Fact Is, There's Nothing Phoney About This 21st Century Buzz-Wagon. Step This Way, Boys, Right Into Any Automobile Confectionary Store. They Will Sell You All Your Electrical Rinktums—and Lots Besides. We Would Have Stuck a Few More Gross Onto Our Flivvernacular, Only the Artist Went Bluey and Struck for Less Art and More Pay.

THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

ROGERS GROUND ANTENNAE.

(1030) H. I. Middleton, Hendersonville, N. C., asks several questions in reference to Rogers Underground Antennae:

Q. 1. If bare wires can be used as underground antennae (as per article in June, 1919 EXPERIMENTER), why can't waterpipes, etc., which are available and already buried, be used?

Q. 2. If a bare wire is used for underground antennae, how and why should it be connected to the regular "Ground" wire which diagrams in June article call for?

Q. 3. In what order of efficiency will the following styles of antennae rank, viz: Regular Tower Antennae, Tree Antennae, Underground Antennae?

Q. 4. Will the Tree Antennae and the Underground Antennae require specially constructed or sensitive receiving instruments (audion, etc.), or will they work just as well with the usual Amateur Receiving Sets?

A. 1. With reference to the Rogers underground antenna, and as to the reason why ordinary waterpipes, etc., cannot be used for aerials, would say that such piping systems buried in the ground have yielded very good results in some cases for the reception of radio signals, tho usually they do not correspond in efficiency to a well-laid Rogers antenna. Also in the case of the latter, there is an added advantage of high conductivity in the copper conductors as compared to ordinary waterpipes, and, contrary to the average opinion, common water is not a good conductor, but a very poor one, with a consequent high resistance.

A. 2. With respect to the connection of a bare wire Rogers antenna thru the receiving apparatus and then to the usual ground connection, would say that the Editor of the "Oracle" has personally heard signals coming in with a high audibility, using the antenna only, with no connection to the usual ground. But when the ground is also used in connection with one of these buried antennae, the signals come in somewhat louder. The whole philosophy of the Rogers underground aërial and its operation is, it would seem, based on the simple fact that the copper wires buried in the ground, whether bare or insulated, are many times higher in conductivity than the ordinary earth, and therefore due to this conductivity an appreciable radio current is induced and interpreted thru these conductors.

A. 3. The probable ratio of antenna efficiency would be (a) regular elevated antenna, (b) underground antenna, (c) tree antenna. The underground antenna does not always show as high an efficiency as some of the large elevated aërials in use at some of the Government stations, but it invariably has the advantage of the elevated antenna during periods when there is an appreciable amount of static, and signals can be copied on the underground aërial thru thunderstorms without the least danger, or without any interference from static.

A. 4. We cannot say as to the sensitivity required in the radio receiving instruments to be used with tree antennae as developed by Major General Squier, but would presume that any ordinary audion receiving set would give good results. The usual apparatus employing an audion detector may be used with great success with the Rogers underground antenna, and when the writer visited Mr. Rogers' laboratory he was using but one detector and amplifier, namely, an *audiotron* bulb. This bulb was connected up so as to oscillate when desired, in order to receive the undamped wave stations.

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New stations, both commercial, government, and private. Owners of private or amateur stations will find a special contest for these photos on another page of this issue.

And don't send us plate or film "negatives"; send unmounted or mounted "prints", preferably a light and dark one. Enclose stamps if photos are to be returned and place a piece of cardboard in the envelope with them to prevent mutilation.

Address photos to—Editor "Odd Photos", Electrical Experimenter, 233 Fulton Street, New York City.

You will find an interesting article on the tuning of underground antennae to optimum wave lengths, by J. Stanley Brown, in the "Radio Amateur News" for July, 1919.

DATA ON FIVE-COIL LOOSE COUPLER.

(1031) M. R. Smith, Winnipeg, Man., Can., writes the "Oracle":

Q. 1. What are the dimensions and what size wire is used in the construction of the "Five-Coil Loose Coupler" shown on page 74 of the May issue of your excellent magazine, which is used by Samuel D. Cohen in his "New Regenerative Vacuum Tube Circuits"?

A. 1. We are pleased to give herewith information you request on the five-coil loose coupler.

L_1, 10 inches long, 7½ inches in diameter, wound with No. 20 silk-covered wire.

L_2, 8¾ inches long, diameter 6⅛ inches, wound with No. 26 silk-covered wire.

L_3, 8¾ inches long, diameter 5½ inches, wound with No. 20 silk-covered wire.

L_4, 4 inches long, diameter 7½ inches, wound with No. 20 silk-covered wire.

L_5, 4½ inches long, diameter 5½ inches, wound with No. 20 silk-covered wire.

PHAROAH'S SERPENTS.

(1032) E. F. Rightsell, La Grange, N. C., inquires:

Q. 1. Can you give me the formula for making the fireworks novelty called Pharoah's Serpents? It is a small pill or cube which when lighted will burn and the ashes will extend outward in the shape of a snake.

A. 1. The formula for making Pharoah's serpents, altho very efficient, is not generally used in the house, inasmuch as when these chemicals are combined to form the serpents they cause a strong odor of burning sulfur.

The following formula, however, may be adapted to both indoor and outdoor entertainments:

Potassium Chromat.....2 parts
Potassium Nitrat.....1 part
White Powdered Sugar.....2 parts

Powder each ingredient except the sugar very carefully. Then spread the powders on a piece of paper, and by carefully working with a spatula insure a thoro mixture of the ingredients. Moisten with a little alcohol and work into a paste. Now form into pellets about the size of a pea, or, in fact, any size desired, and allow to dry. These should be very carefully covered with a layer of tin-foil or tin-foil wrapping and placed in a large box, so that accidental friction will be almost impossible. Do not use a box with a slide cover, as friction when the cover is removed might cause harmful results.

Will Captain Smith return to Floorwalking?

There are thousands of men like Captain Smith who, before the war, were occupying relatively unimportant positions in the business world. Then, in a few months after the call to colors, they were holding commissions in the army. Millions of others found their way from positions in all walks of life into the various camps, where intensive training quickly turned a nation of business men into the world's finest fighting machine. It almost seemed incredible—but what this array of business men and workers did as "their bit" is now history. What took Germany forty years to prepare for was done in a few months by America. This record was made possible only by INTENSIVE TRAINING.

Though Captain Smith may return to his old job of floorwalker, it will be only for a short while—time enough to complete a course of intensive training in some line or other that will make him mentally fit for a better paid and more responsible position. He knows that intensive training will do this for him just as surely as it qualified him for a commission in the army.

Intensive training made him a leader of men. It enabled him to give orders instead of taking them. It enabled him to think, act and reason for himself and do the thinking for those under him—often a matter of life and death. No! Captain Smith couldn't be content in his old job, because he knows how to get a better one.

The War's Great Lesson

Every man who stepped from his job in civil life into an intensive training camp has learned a valuable lesson—a lesson that will make him a better business man if he but has the will to win. These men have witnessed the wonders of intensive training—have seen the metamorphosis in their own individual lives as well as in those of others, and it is but natural to assume that, if intensive training in military matters performed such wonders, it must have the same beneficial effect when applied to business. The history of business and of business successes points unerringly to the assistance rendered by intensive training.

Since the armistice was signed, and more particularly since the American troops began to arrive home, there has been a noticeable increase in the number of enrollments for intensive business training in all lines of endeavor taught by the American School. Thousands of men who were simply "getting by" instead of "getting on" before they joined the colors, have learned a lesson and they are not going to be content with the poorly paid jobs they held in the past. This fact is proved by the great increase in students who are availing themselves of American School training. In a few months these students who are now applying intensive training as a solution of "how to get on," will be able to qualify for the goal they have in mind. The spare time hours they devote to this training will bring them rich rewards in the form of bigger pay checks, better positions and more congenial work. The result of such training cannot be otherwise, for trained men are the scarcest commodity on the market.

After seeing what a few months of intensive training did for him from a military standpoint, he, and thousands like him, are going to avail themselves of the same method as a means of self-betterment in business life. There's proof below that it's the only way to secure promotion and much better pay.

An Investment Without an Equal

If you think for a moment that there is another investment that can equal the time and small amount of money spent in intensive training—get out your pencil and do some figuring.

If a course of intensive training in your chosen line costs you from $50 to $100—and your spare time—how much would that money earn for you if invested in stock? From three to ten dollars per year would be the limit, wouldn't it?

The same amount invested in intensive training will double, treble or multiply your earning power several times, because it makes you a better business man and makes those who employ you aware of that fact. There's no sentiment in determining salaries. You get paid for what you can do—and that depends solely on what you know.

Your spare time does not earn you anything NOW—so you can't charge anything to a course of intensive business training but the actual cost of the course. If the result of this training only increased your earning power by ten dollars a week—and that is a conservative figure—you would net FIVE HUNDRED AND TWENTY DOLLARS a year from a small investment of cash and spare time. That is a small gain when compared with actual returns reported by American School students, but small as it is it serves to prove that there is no other investment in the world that pays so well as a trained brain.

Thousands Bettered by American School Training

It has been the privilege of the American School, a fully chartered educational institution, to prepare thousands of ambitious people for better positions in all trades and professions. For nearly a quarter-century it has been advocating intensive training, and, today, there are thousands to testify to its efficacy—thousands who are now enjoying healthy incomes and congenial work as a result of the spare time they devoted to American School training. The same measure of success can be yours. Proof of scores of these successes will gladly be mailed you on request.

A School That Is Known by Its Guarantee

The American School believes that education, like merchandise, should be sold on a "make good" basis. Doing business strictly by mail demands some guarantee as a protection to the student. That is the belief of the American School—and it is on the basis of SATISFACTION OR MONEY REFUNDED that a student enrolls. All risk on the part of the student is eliminated. At any time during the first year of your enrollment we guarantee to refund your money in full if, after the completion of ten examinations, you notify the School that you are not satisfied with your course. Ten examinations will prove to you whether or not you are getting practical, money-making training. You are the judge.

Don't Dodge a Better Job

Whether you get a better position and better pay is up to you and you alone. The American School can help you get the position you want—just as it has helped its thousands of students. It will not obligate you to investigate what this training means to you. A Free Bulletin will be mailed you on receipt of the coupon. No agents will call on you—and it might prove the best thing you ever did. Check and mail the coupon while this matter is before you.

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.....Architect	.....Master Plumber
.....Building Contractor	.....Heating and Ventilating Engineer
.....Civil Engineer	
.....Structural Engineer	.....Automobile Engineer
.....Mechanical Engineer	.....Automobile Repairman
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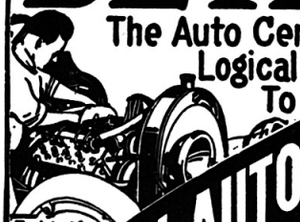

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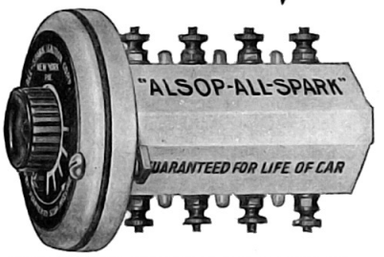

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The Electrical Machinist

By H. Winfield Secor

(*Continued from page 775*)

moving any commutator, to note and record its exact position on the shaft; a center punch mark should be made on the armature drum or core, and another corresponding mark on one of the commutator segments. Thus, when the commutator is being replaced these two marks should be lined up. This is very important from an electrical standpoint, and it also is the best from a mechanical standpoint for obvious reasons.

Small commutators are frequently driven into place on the armature shaft by means of a piece of pipe which fits over the shaft, and then this pipe is hit with a heavy hammer or sledge, driving the commutator on in this fashion. Where the commutator does not make an extra tight fit on the shaft this method is quick, it may be said, but it is very poor practise, except when applied by an experienced mechanic who can judge when this process is requiring too heavy a blow. On small armatures there is a danger of bending the shaft. It is best to upend the armature and shaft in a vertical position when attempting to drive on a commutator in this fashion with a sledge and a piece of pipe. The commutator may rest on a piece of fiber or in some cases an iron plate is used, but the latter is liable to damage the end of the shaft.

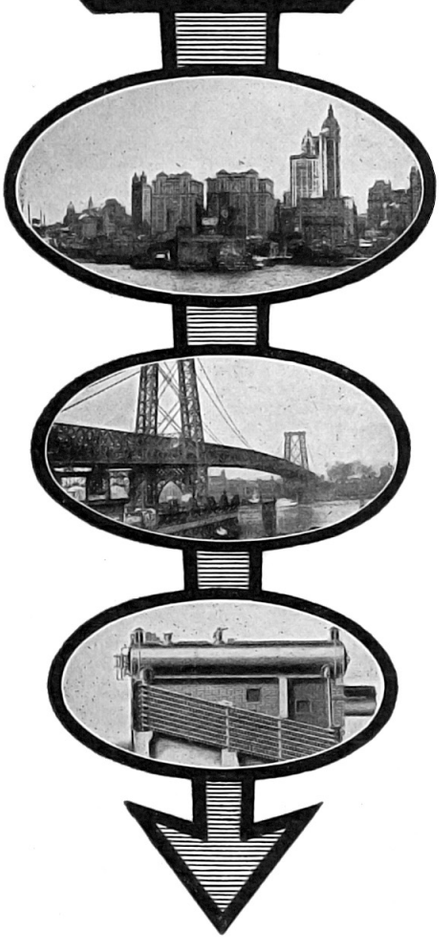
When a shaft becomes bent, for one reason or another, one of the best methods of straightening it, is to place it between centers on a lathe. Small shafts can be easily straightened without applying any heat, but large shafts two or three inches in diameter and more, should have heat applied to them before attempting to bend them straight. The first thing to know is the actual position of the bend, and pressure should be applied on the opposite side of the shaft or armature drum from which the bend springs. Pressure may be applied in several ways. In some cases, a lever or a piece of plank is used on top of some blocking on the lathe bed, while in other cases, pressure may be applied by means of the lathe tool carriage, utilizing the slowest hand-feed possible on the carriage. Considerable pressure can be obtained in this way, but it is not advisable for any large work, as it is liable to strain the lathe machinery and either break or bend some of the gearing and connecting shafts on the tool-carriage.

MISCELLANEOUS COMMUTATOR CONSTRUCTION HINTS.

At figure 4 are illustrated several practical hints in commutator construction. At A, there is shown a method of building up cone-shape mica rings used in insulating the ends of the commutator barrel or drum. These rings are usually built of *shellacked mica*, a standard form of this material in the electrical trade, and which comes in the form of sheets of various thicknesses and sizes. This shellacked mica sheet is first cut out in segments or other shapes of predetermined dimensions, such that when they are heated above a Bunsen flame, they may readily be bent to the exact size and form of the cone required. In completing such a ring, the segments are overlapped as shown by the dotted and full lines in Fig. A. The segments are shellacked as they are built up in the cone form. A wooden form of the proper taper may be turned up for the purpose, or else the commutator shell itself may be used for the purpose. Cement mica is widely used in commutator work, but mostly where flat position of insulation, such as commutator segments, are required.

(*Continued on page 790*)

Be a Draftsman
Raise Your Income



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Never before in this country was there such a demand for skilled draftsmen—and this condition is true of European countries in which the destruction of war calls for vast re-building programs requiring the services of an army of draftsmen. All this world-wide demand means great prosperity for men who become trained in draftsmanship.

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The longer you wait, the longer you will postpone the time when you will begin to draw a tempting salary as an Expert Draftsman. Manufacturers, Architects, Contractors, Engineers, Builders, Railroads and other big employers of trained draftsmen are ready with the work—when you are qualified to handle it.

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Whether you decide to take one of the resident courses or to study in spare time at home you will have the personal direction of practical engineers, builders and architects, who give you the benefit of their vast experience and the successful methods they use in their own work. No time wasted. Every minute counts under men like these—every one a specialist!

We train hundreds of men by the most modern methods and see them quickly succeed, because we give them a technical preparation that not only makes proficient draftsmen of them, but also enables them to fill higher executive positions in big construction enterprises. There is no limit to your progress after you have equipped yourself with what the Chicago "Tech" can give you.

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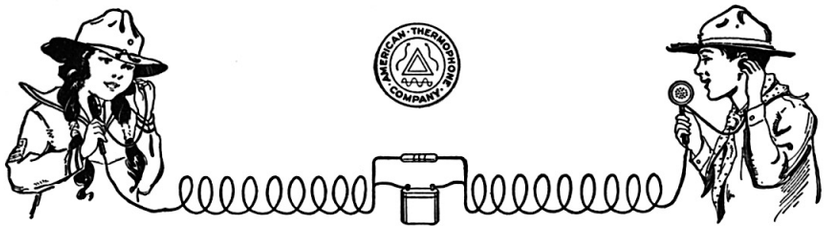
KIDPHONE

TRADE MARK



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The "Kidphone" is sold as a toy, but it is more than a toy—it is a practical, durable, superior telephone. Although it is much smaller and weighs much less (receiver weighs ¼ oz.), it talks better than the one you're used to. The idea of operation is different. It is based upon the correct theory of voice transmission, introducing to America for the first time a far-reaching, scientific principle, only recently perfected. Can be used for all sorts of purposes—in the house, in the play-room, on "Scout" duty, in games, etc.

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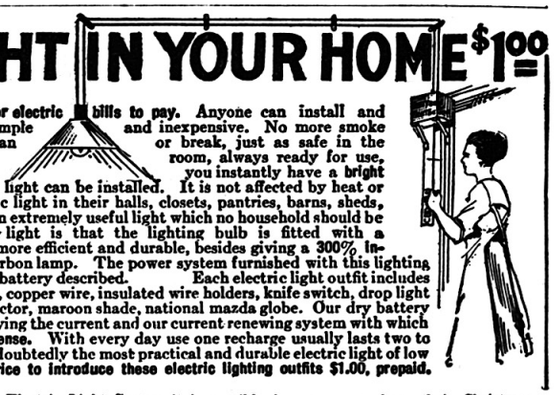

The latest electric light, no batteries to buy or electric bills to pay. Anyone can install and maintain this midget electric light. Safe, simple and inexpensive. No more smoke and smell, no wicks or oil, no chimneys to clean or break, just as safe in the barn, garage and clothes closet as in any open room, always ready for use, day or night. A touch on the switch and you instantly have a bright electric light. No matter where you live this light can be installed. It is not affected by heat or cold. Many homes have installed this electric light in their halls, closets, pantries, barns, sheds, cellars, garages, etc., with good results. It is an extremely useful light which no household should be without. The reason for this bright electric light is that the lighting bulb is fitted with a drawn Tungsten filament wire which is much more efficient and durable, besides giving a 300% increase in light as compared with the ordinary carbon lamp. The power system furnished with this lighting outfit is somewhat similar to the electric power battery described. Each electric light outfit includes the following: Complete directions and plans, copper wire, insulated wire holders, knife switch, drop light fixture with socket, friction tape, battery protector, maroon shade, national mazda globe. Our dry battery compound, which assists in renewing and supplying the current and our current renewing system with which you can renew the current at home without expense. With every day use one recharge usually lasts two to three weeks. This electric lighting outfit is undoubtedly the most practical and durable electric light of low cost and long service ever devised. Special price to introduce these electric lighting outfits $1.00, prepaid. Outside the U. S. $1.25.

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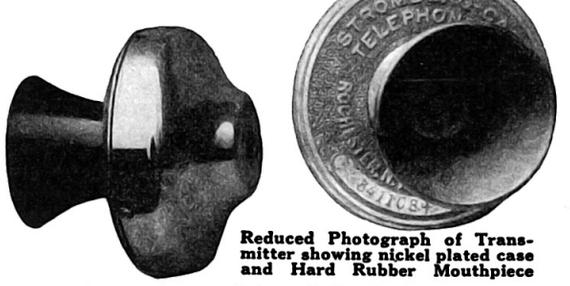

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THE ELECTRO IMPORTING CO., 231 Fulton St., NEW YORK

The Electrical Machinist

By H. Winfield Secor

(*Continued from page* 788)

In small commutators the segment insulators are usually made of pure mica punched out by a large motor-driven punch-press. It is usual in practise to make up a commutator gage stick as shown at Fig. 4—F. The mica punchings are assembled in the saw slits cut in this stick, the saw used in making the slits being of the exact thickness of the mica segment desired. One large motor concern uses wooden sticks, but they can of course be made up of other material. Several rubber bands are used in assembling small commutators as the mica and copper segments are put into place. At C, there is shown the method of scribing out the exact shape of mica segment for large commutators by laying the copper segment on the mica. At D and E, there are shown respectively, the use of a steel snap-gage having a slot of predetermined width and also the use of the *micrometer* for gaging the thickness of mica segment in thousandths of an inch or mils. In tightening up commutators some form of compression is generally employed, such as that shown at B. This is a wrought iron ring, several of which may be used on long commutators, and steel set screws are threaded thru the ring all around its perifery. These set screws may be spaced about two segments apart, and under the screws and over the commutator segments there is placed a thin band of iron or copper. The segments are thus tightened up and at the same time the lock nut on the end of the commutator is successively and periodically tightened. The commutator must in any case be just as tight as you can possibly make it, within reason of course, before any attempt is made to place it in the lathe and machine its surface, or otherwise there will be commutator segments in every corner of the shop, before many cuts have been taken.

(*To Be Continued*)

MAGAZINICALLY SPEAKING.

An *American, Country Gentleman,* wanting some *Variety* in his *Life,* and desirous of becoming an *Electrical Experimenter,* purchased at the *House Beautiful* a copy of *Popular Mechanics,* which contained many *Popular Current Events.* The *Engineering* in this *Journal* enabled him to become a good *Judge* of *Aircraft,* and consequently his *Outlook* for a *Success* was due to the *Modern Methods* taught by this *System.*

This *Craftsman,* having read some *Live Stories* in the *Scientific American* about the mines in San Francisco, decided to make a *Motoring* trip to the *Cosmopolitan* City. On arriving at the western city he did not heed the *Call* of the *Mining* center, but visited the *Motion Picture* studios, where he became acquainted with the *Photoplay.* The splendid atmosphere in this *Town* aided him to improve his *Physical Culture. Every Week* he would take a *Yachting* trip on the *Pacific* and enjoy the beautiful *Sunset.* One evening while a *Spectator* of a new *Film* at a leading *Theater* he met a young lady of *Fashion.* The next *Day* while at the town *Post* waiting for his *Mail* he again met the young woman. He liked her very much and soon became the *Woman's Companion.* They were soon married and went to live at the *Countryside.* The couple lived very happily and while the young woman was engaged in *Good Housekeeping,* the old gent sang extracts from *Musical America.*—*Art Mayers in the "Everett Herald."*

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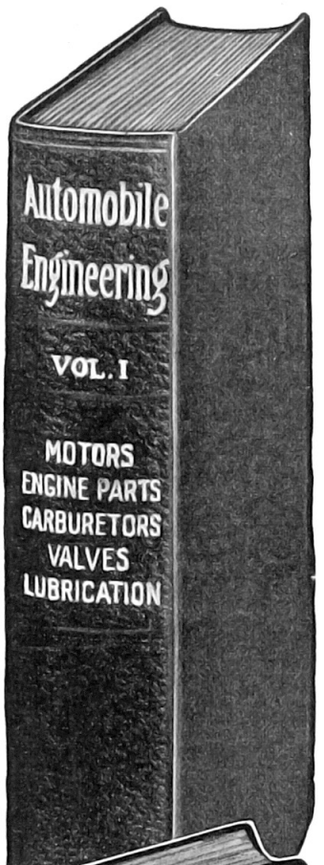
THOUSANDS of men like you are wanted to fill these big-paying jobs in the automobile engineering field. Thousands of places are open, too, for chauffeurs and garage managers. It's easy to get one of these good jobs and to prepare yourself to hold it. You don't have to go to school. You don't have to serve an apprenticeship. Spare time only is needed. These great automobile books will teach you everything you need to know. Fifteen of the greatest engineers and experts in the business wrote them in simple language that anybody can understand.



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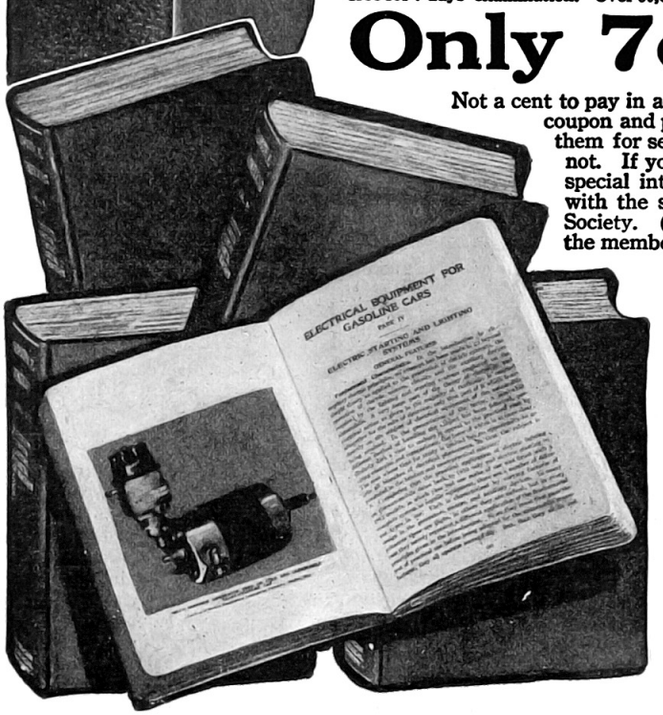

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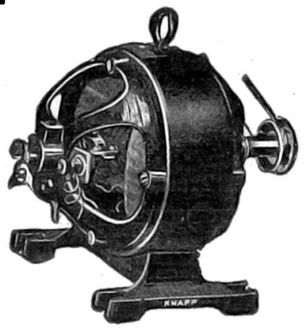

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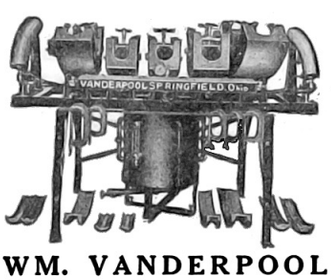

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The United States has only six per cent of the population of the world and only seven per cent of the land, and yet we produce the following percentages of the world's supply:

Of copper	60%
Of lead	40%
Of zinc	50%
Of aluminum	60%
Of oil	66%
Of corn	75%
Of cotton	60%
Of silver	40%
Of coal	52%
Of gold	20%
Of iron and steel	40%
Of automobiles	85%
Of wheat	25%

and refine 80 per cent of the copper and operate 40 per cent of the world's railroads.

The Amateur Magician

By Joseph H. Kraus, Jr.

(*Continued from page* 771)

Again no movement on the part of the bell. "Well, I'll not fool any longer. The bell doesn't know." He was interrupted again by the "yes" ring of the bell. "How strange and yet—perhaps she does know. Was it a Diamond card?"

The bell answered in the affirmative.

Scratching his head the performer as tho choosing his words with great deliberation added, "Was it a picture card?"

The bell answered *yes*. "A King?" Two rings signified that this was correct.

"Not only does the bell tell me these things, but also tells fortunes. Now, bell, suppose that you tell me how many fellows that young lady down the aisle has. Four? Thank you."

In this way a long program may be mapt out and wound up in the following manner:

"The lady in the box there; yes, the married one. How many times has she been married?"

The hammer is seen to rise once, twice, but it only rises on the third occasion, not striking as it did on the previous occasions; while the magician watches with interest the next move, counting out loud.

"Twice, and almost the third time?" this with an inflection of the voice. "Here that will do." Separating the parts as before he bows to the audience.

THE CONSTRUCTION OF THE BELL AND STAND.

The stand consists of a long nickel-plated tube mounted on a tripod of the same material, with one wire running up each of two of the three legs, said wire connected to a large magnet made by winding eight layers of number eighteen doubl cotton covered magnet wire, on an iron core which does not extend all the way up the coil; but terminates within one inch of the end, a sleeve continuing the rest of the way. The coil is eight inches long and actuated by an assistant behind the scenes, a six volt current being used as the exciting force.

The hook is made of iron, nickel-plated, like the balance of the stand. When placed in position it acts as a core to the magnet concealed in the stand.

The bell is made of an ordinary electric light globe, which is fastened into a turned piece of wood (as shown in the illustration) with plaster of Paris. Thru a small opening in the ring on top is past a piece of soft iron bar, one end of which is connected to a lever-like piece of aluminum; the far end of this lever has a decorative piece of bone attached to its free end to act as a hammer.

(*Continued on page* 794)

Become a Doctor of CHIROPRACTIC

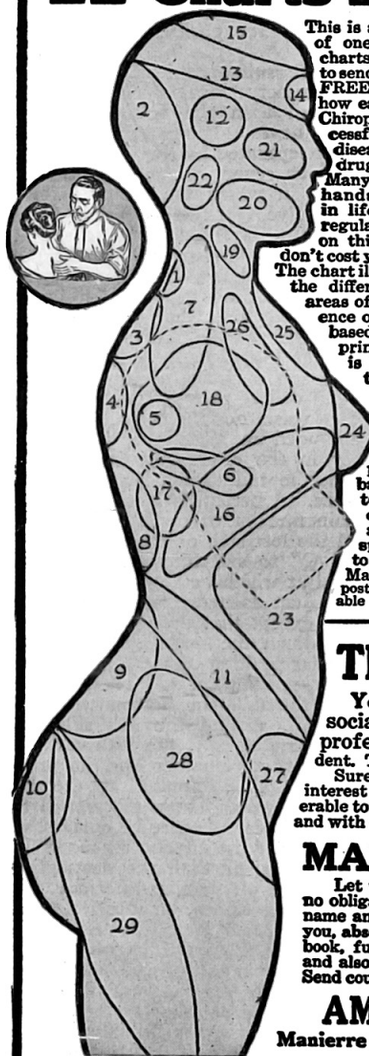
Advanced Science of Spinal Adjustment

The great profession that within the past few years has taken the longest forward strides ever known in the history of drugless healing. It has called to its ranks thousands of ambitious men and women from every walk of life. Today it is calling more insistently than ever because the tide has turned strongly in favor of drugless healing.

There is today a demand for one hundred thousand Doctors of Chiropractic in this country, according to a recent statement of a man who is himself a prominent Chiropractor and has intimate knowledge of the Chiropractic situation throughout the United States.

Even if this demand remained stationary, it would require many years to fill it. But the demand is **constantly increasing** because more and more intelligent people—those who do their own thinking—are becoming convinced that Chiropractic is the common sense and really scientific way to relieve pain and disease.

22 Charts FREE!



This is a small reproduction of one of 22 magnificent charts all of which we want to send you ABSOLUTELY FREE, just to show you how easily you can master Chiropractic and how successfully you can treat disease by this modern drugless healing method. Many of these charts are handsomely lithographed in life-like colors. Their regular value is $31.50, but on this special offer they don't cost you a penny.

The chart illustrated here shows the different pain and nerve areas of the body. The science of Chiropractic is based upon the well known principle that when there is bone pressure on a trunk nerve where it leaves the spinal column there will be pain in the area it controls; and that by relieving the pressure the pain is banished. Chiropractic teaches you how to locate nerve pressure at any point along the spinal column and how to relieve it.

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or in class. Our method of home study instruction places you under the personal direction of a splendid faculty of Chiropractic experts—men who have made notable records both as practitioners and instructors. There is no need for you to leave home or give up your present position. Your instruction will be thorough, practical and in accordance with the most modern methods of drugless healing therapeutics. From the moment you enroll we will work with you wholeheartedly, our one aim being to make you successful just as we have advanced the interests of thousands of others. In the shortest time consistent with thoroughness you can graduate with the degree of D. C. (Doctor of Chiropractic) receive your diploma **FREE**, and be ready at once to open your office. Your opportunities are as great as those of other ambitious men and woman. Why, then, shouldn't you be able to do as well as Doctors of Chiropractic who are today earning incomes of from

$3000 to $5000 a Year

and even more? What, for instance, is there to prevent you from doing as well as Dr. Condoluci, one of our recent graduates, who writes us that he earned from two to three times the cost of his tuition **as a student;** that immediately upon graduation he opened an office, began making money from the very start and is now earning **upwards of $12,000 a year!**

Another recent graduate, Allen Watrous writes: "Am contemplating opening a large office with 50 stretching tables. A man who is interested will put up $25,000 to make this possible." Dr. W. H. Wedell states that his practice averages ten patients a day and that he charges $25 for 13 treatments. At that rate he's making big money. Dr. M. D. Moore reports an income of $9000 a year; Dr. L. H. Roche, $5000. Dr. Hanna over $5000 yearly. Can you ask for more convincing proof that CHIROPRACTIC is indeed a great profession—a fertile field for men and women who feel that they can and should make more of their lives and are earnestly seeking broader opportunities?

Yes, the success of many Chiropractors has come so quickly as to be almost startling. And yet, it is not to be wondered at when you consider the scientific accuracy of Chiropractic methods, the constantly increasing demand for Doctors of Chiropractic and the comparatively few Chiropractors that are now in the field.

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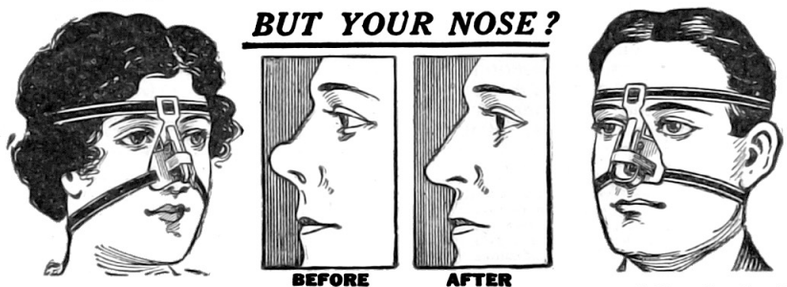

BEFORE AFTER

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Wading River Mfg. Co. 672 Broadway, Brooklyn, N.Y.

The Amateur Magician

By Joseph H. Kraus, Jr.

(*Continued from page 792*)

Two wires lead thru the stand and down each of two of the legs, making contact with two plates concealed by the heavy rug.

When the stand is brought forward, it is carefully placed in position so as to make contact with the two plates, the bell then being tried before proceeding with the balance of the performance. The trial is made under cover of a little phrase, asking the bell to show how it answers. A typical magician's forcing deck of cards being used, the assistant knows exactly what cards will be given out and goes thru the procedure as a regular matter of routine; pressing the key for each sound of the bell and the gong ringing at each break of the circuit.

It will be noted that when the soft iron core is attracted to the magnet, the hammer is pulled away from the bell, but on its sudden release the weight of the hammer allows it to swing downward, striking the bell just once.

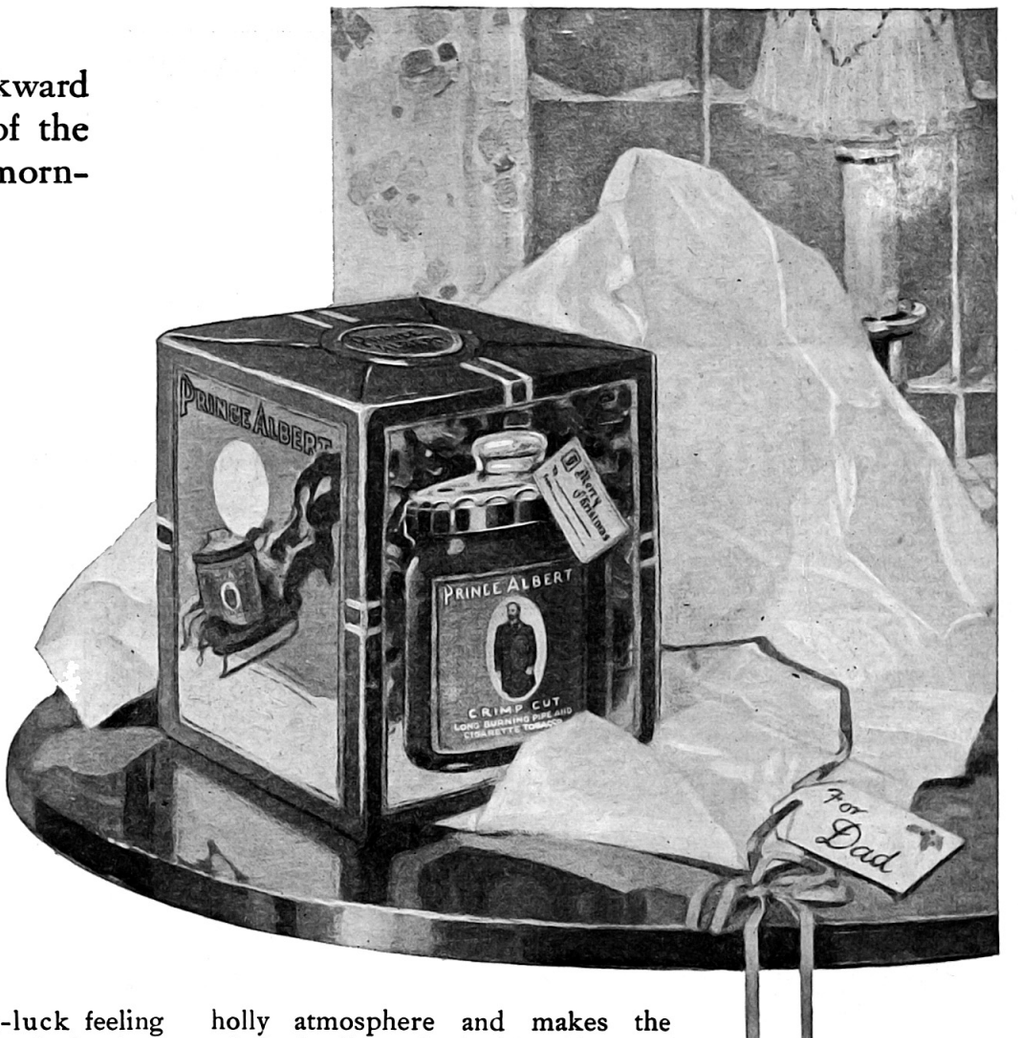
A FEW TRICKS EASILY PERFORMED BY THE "FIXT PACK."

This trick originated many years ago. It never fails to produce results. The cards are fixt in an orderly manner, and this order preserved—*the deck never being shuffled*. This order is very easily learned, and it is only necessary to see one card in the deck, either the top or the bottom card, to be able—in this manner, to tell the name or the position of any card in the deck.

First—the suits are learned in the following manner: Hearts, clubs, diamonds, spades, and then the following arrangement will be found very satisfactory. The cards are separated by three numbers; that is, one, four, seven, ten, thirteen, three, six, nine, etc., in which the King is thirteen, Queen twelve, Jack eleven and the Ace is one. In arranging the cards, they will follow this manner: Ace of hearts, four of clubs, seven of diamonds, ten of spades, king of hearts, etc. In this way you can easily tell what the twelfth card in the deck will be and read the cards off without looking at them; also by giving a person a choice of any card in the deck, you will be able to discover just what that card was. For the "Q" trick, the cards are arranged in a definite manner. Any number in the circle and the number of cards in the tail changed after each performance. A person is instructed to count a certain number of cards up the tail and around the left side of the circular portion of the "Q" to suit himself. Then taking that card at which he stopt as number one, counting just as many cards, retracing his course, (except that this time he does not proceed down the tail), continues around the circular position of the "Q," stopping in a similar position, i. e. There are eight cards in the tail—the person will proceed up the tail, around the left side of the "Q," stopping at, say, the 17th card. Taking this card as number one, he proceeds backward again, stopping at the seventeenth card again. The performer instantly tells him this card before he comes back.

So much for the effect. Its mode of operation is simpler than the description of the trick and all that is necessary, is that the performer know the number of cards in the tail. Using the card from where the tail starts, as his starting point, he stops at the same card as the number of cards in the tail. In the example mentioned above, it would be the eighth card (inasmuch as there are eight cards in the tail) from your centre position, that, is, where the tail joins the "Q." A simple trial will readily convince.

TAKING awkward angles out of the early Christmas morning atmosphere!



HOW that low-on-luck feeling will peel off *his* mind when the happy-handout-happens Christmas morning; and, his keen eye sights the stage all set with the pound crystal glass humidor of Prince Albert tobacco gowned in the glories of a radiant holiday rainbow! Turkey takes to the tall timbers compared with the all-star-feast *you* spread so temptingly before his smokeappetite!

PRINCE ALBERT, for Christmas, lands on a man's tank-of-thanks like a spill-of-snow when the sleigh-bells are rusty from lack of jingles! P. A. as a *man gift* is the high-sign, the last word, the directest route to his comfort, his contentment, his smoke-happiness! It's the touch-that-lifts-the-lid; that takes the awkward angles out of the evergreen-and-holly atmosphere and makes the whole family on both sides think and talk in one language!

YOU'LL enjoy seeing *him* fuss his old jimmy pipe, all-brimful with Prince Albert! Or, *getting his* "rolling his own!" Never was such a delightful makin's cigarette as P. A. supplies. He can smoke the limit with Prince Albert *for it can't bite his tongue or parch his throat!* Our exclusive patented process fixes that! He'll just want to get thirty-six-smoke-hours out of the legal twenty-four, *that's all!*

FILL his smokecup to overflowing! Prince Albert is the glad-gift, the holiday-hunch that will hum him a smoke te-de, te-dum long, long after Christmas is but a merry memory!

PRINCE ALBERT is also sold in handsome pound and half pound tin humidors, in tidy red tins and in toppy red bags—wherever you buy tobacco.

R. J. REYNOLDS TOBACCO COMPANY
Winston-Salem, N. C.

PRINCE ALBERT

the national Christmas joy smoke

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What could you do?

Once to every man comes a time when he must fight for his life or the safety of a loved one.

It may come in the dead of night in your own home, burglars for instance; or on a lonely road or deserted street after dark, or even in broad daylight at the hands of passing bullies.

Suppose it should come to you tonight, what could you do?

Can't you see that it would not be just a question of bravery or strength but rather a question of whether you know how to box, how to defend yourself against the vicious blows of your assailant, how to disarm him if he tries to use a blackjack, club, knife or pistol, how to break his grip on your throat, how to stop the kick he launches at your stomach, and finally how to cripple him by a jiu-jitsu or bone-breaking hold?

Wouldn't you like to know how to play a man's part? Wouldn't you like to learn boxing and self-defense easily and quickly *at less than half the cost* of a single term of lessons by the old method?

Marshall Stillman has developed a unique principle of teaching boxing and self-defense. Two weeks after taking the course boys of twelve and fifteen, and men up to even fifty and sixty have been able to defend themselves against bigger and stronger opponents. He teaches the fundamentals of boxing in five lessons before your own mirror, so that when you meet your first opponent you know how to hit him, what to expect in return and how to guard against it. He teaches you sixteen bone-breaking holds and releases in jiu-jitsu and standing wrestling so that you can quickly put your assailant at a disadvantage and overcome him. For instance: "When opponent tries to use blackjack or other weapon, grasp his wrist with your left hand and immediately slip your other (right) arm well up under his arm and, reaching up, grasp his weapon-hand from behind. Then with both of your hands force his forearm back, as illustrated above. You can break his arm if necessary."

And while he's teaching you these things, he develops you physically and makes your daily exercise interesting as well as beneficial.

It is the first time boxing and self-defense have been successfully taught by mail, and it is only possible because of the Marshall Stillman principle of instruction.

The complete course *specially bound for home study* includes:

5 lessons in boxing—how to hit, duck, guard, feint, clinch, and use foot work.

3 rounds of shadow boxing.

1 set of daily exercises for muscle building.

8 jiu-jitsu holds and releases.

8 holds in standing wrestling.

1 free copy of Professor Mike Donovan's famous book, "The Science of Boxing," containing all of the scientific blows and guards known to the ring, the rules of boxing, suggestions on training, diet, etc.

There are 175 illustrations in this course. The *special Introductory Price* for this in Home Study Edition is, *until further notice*, only half of our usual price—$5.00 instead of $10.00.

It is almost unbelievable that you can learn these things by mail, but we are willing to take all the risk of convincing you. We will send you the complete course on 5-day approval. If you keep it send us $5.00 in full payment; if not, return it on the 5th day. Fill out the coupon *now*.

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Send on approval the Marshall Stillman Course in Boxing and Self-defense including 5 lessons in the principles of boxing, 1 set of daily exercises, 3 rounds of shadow boxing, 8 jiu-jitsu holds and releases, 8 holds in standing wrestling, and a free copy of Prof. Donovan's book "Science of Boxing." I will either return them or remit $5.00 on the 5th day after I receive them.

Name .....

Address .....

"Slow Movies" Analyze Motion

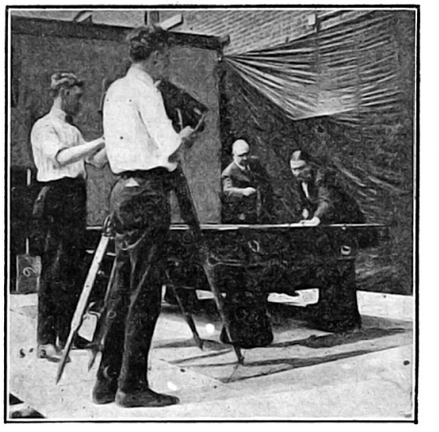
(*Continued from page* 751)

er in the light. This is so because our eyes can only perceive and analyze those movements which do not travel at a greater speed than sixteen times per second. Let us illustrate with an example: Suppose we look out thru a window at a man walking. If that man makes sixteen steps from the time he enters the left space until the time he leaves at the right margin of the window, we will be able to clearly perceive and count each one of these steps. However,

Taking a "Slow Movie" of a Motorcycle Race at 200 Pictures Per Second.

should that man travel at a greater speed than sixteen steps per second, his step movements will be blurred. Hence, when a camera takes pictures at such an extremely rapid rate, and projects them at the normal speed, it means a slowing down of the picture and the slow movement. Hence the twitch of all the muscles is instantly noticeable. If you have ever been to a theater which has exhibited a Novagraph production of diving, you will more than wonder at the gracefulness of the girl in this scene, as she executes some of the most difficult and wonderful dives. Compare these with the expert male swimmer, going thru the same dives—a striking contrast of his muscular movements with the gracefulness of the girl.

Hundreds of uses for this machine have already developed and suggested themselves. Aviators in flight have been photographed while executing tail spins, nose dives, etc. A movie of Ralph de Palma in his record-breaking Packard, moving at the rate of 130 miles per hour, produced a negative which even rendered the buttons of his uniform visible.



"Slow Movies" Permit of Accurately Analyzing Fancy Billiard Plays, Airplane Tail Spins, Etc.

HERE IT IS

Final Solution of the Vibrator Problem Absolutely Astonishing

NEWEST and Greatest Invention

You know that Vibration means new life, power, health, beauty. You know it is Nature's way to banish pain and to give you new energy and vitality. You know all this, but do you know that the BIG problem of science has been to devise a hand vibrator that would be absolutely satisfactory in every way? That problem has vanished. We solved it. Our NEW, wonderful Vitapulser is GUARANTEED to effect ALL the astonishingly beneficial results made possible by this approved method of treatment.

THE VITAPULSER

Is practical. It requires no connection with electric wires—supplies its own power. Safe, light, compact, easy to handle and cannot get out of order. It is the modern choice of physicians and thousands of careful buyers.

EVERYONE CAN AFFORD This Marvelous Instrument

If you have not been able to afford a Vibrator on account of the high price, here is your opportunity to own one. *No income too modest to afford The Vitapulser:* sells for a fraction of price of others. Don't be dull, weak, mentally or physically depressed. Learn about the Vital Impulse; how to gain real health and Natural beauty. *The Vitapulser will make you over.* Give us a chance to prove it!

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for testing purposes. No obligation to buy. Write today for FREE remarkable book, "The Vital Impulse" and Special Approval offer.

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Buy Clothes From Maker, Save 30%

That's one sure way to cut the cost of living. Every year thousands of men buy their suits and overcoats by mail, direct from the makers, thereby saving fully 30 per cent. of the cost, at the same time getting the same quality of cloth and workmanship they are accustomed to buy and with the added advantage of having all their clothes hand tailored to their individual measurements.

There is a successful concern in Chicago which has been making men's high-grade, made-to-measure suits by mail for over 15 years, and now has thousands of satisfied customers throughout the country. It would probably surprise the average man to go through their records and see the number of men, even in the big cities, who buy their clothes by mail from this concern.

If you send a postal card to the Ruby Tailors, Department 842, 329 South Franklin St., Chicago, Ill., they will send you free of charge their latest up-to-date Fashion book, containing a number of actual samples of woolens—Fashion plates showing different styles of suits and full instructions for measuring and ordering.

Their long experience in dealing with thousands of men by mail has put them among the leaders in their line and enables them to guarantee to refund the full purchase price of any made-to-measure suit which is not perfectly satisfactory. A number of their customers annually earn substantial sums taking orders among their friends for Ruby Tailored Suits, and the concern makes a very attractive offer to men who desire to add to their income in this way, in addition to saving money on their own clothes. Lose no time in writing for their free Fashion book and complete outfit.

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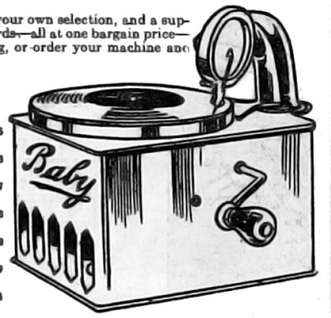
We include, FREE, three double faced records, your own selection, and a supply of needles. You get the machine, needles and records—all at one bargain price—$5.98. In ordering, select records from the following, or order your machine and select your records after complete list reaches you.



Select Your Records

I'm Forever Blowing Bubbles	7685
By the Campfire—Duet	
Dear Old Pal of Mine—Solo	7686
Some Day I'll Make You Glad—Solo	
If It Comes from Dixieland	7697
Rose of My Heart—Teno Solo	
Peter Glak—One Step ..... Band	7673
Some One Step—One Step ..... Band	
How Ya Gonna Keep 'Em—One Step .... Band	7693
What's That—Fox Trot ..... Band	
How You Goin' t' Wet Your Whistle?	7677
St. Louis Blues—Character Song	
In the Land of Beginning Again	7686
Oh, Promise Me	

GENUINE GILLETTE

$4.59

The story is all in the headlines—this is a standard $5.00 razor, silver plated—with 12 Gillette Blades—the best money can buy. Order it either in leather case, or vest pocket pattern, at this very special price of $4.59.

Gillette Blades

These are standard Gillette blades—40c in ½ dozen pack—70c in dozen pack.

MUSCLE BUILDERS

Attach these easily to your wall and use them regularly. Watch your muscle grow. These splendid exercisers for developing muscles have extra coil springs, with Japanned handles, cut to fit the hands. They can be adjusted readily to the floor or wall, at all angles, and will be of enormous value in developing the muscles of the chest, back and arms.

$1.49

Men's Raincoat

Guaranteed Rainproof

$7.49

This is a sporty looking substantial raincoat at a price so reasonable no man can afford to risk getting wet, by going without one. It comes in a snug fitting model, becoming to young and old, with big patch pockets, adjustable military collar and a belt at the waist. Made of rubberized fabric, in olive drab color. An unusual value.

Automatic Cigarette Case, 25c

Hands them out one at a time. The slickest thing you ever saw. Case is nickel-plated, in fancy design, strongly built to last you for years. Men find it most convenient style of cigarette case. Keeps cigarettes in good condition.

HAMMERLESS REVOLVER

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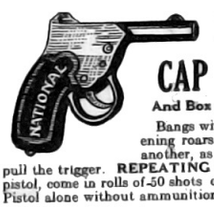
Not a "Baby" but a regulation man's size. Harrington and Richardson Hammerless Revolver. Order by caliber, either size, $10.50 special.

22 calibre, rim fire, 7 shot, 3-inch barrel nickel-plated, 22 short, long or S. & W. cartridge.

32 calibre, centre fire, 5 shot 3-inch barrel, nickel- plated, 32 S. & W. cartridge.

38 calibre, center fire, 5 shot, 3½-inch barrel, nickel-plated, 38 S. & W. cartridge.



50 Shooter Automatic

CAP PISTOL

And Box of Ammunition

Bangs with 50 deafening roars, one after another, as quick as you can pull the trigger. REPEATING CAPS, to fit this pistol, come in rolls of 50 shots each at 5c a box. Pistol alone without ammunition, 25c.

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Looks like a genuine automatic, made of steel, with no rubber bulb to get out of order. Because of the powerful air pressure of the cylinder it will squirt a large stream of water to a great distance. Can be carried in the pocket and used when the other fellow is not looking. Great for fun or self protection.

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With every order received, we will forward, FREE, a copy of our new 1920 catalogue containing many pages of valuable articles at bargain prices. Remit full amount of your order in currency, postal or express money order or 2c stamps. We prepay all postage and express charges.

Satisfaction guaranteed, or money back

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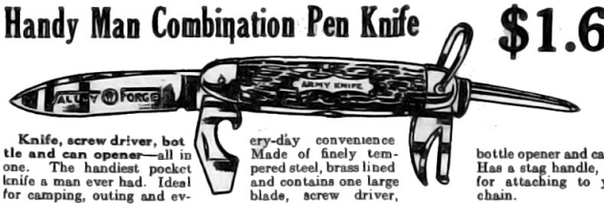

Knife, screw driver, bottle and can opener—all in one. The handiest pocket knife a man ever had. Ideal for camping, outing and every-day convenience. Made of finely tempered steel, brass lined and contains one large blade, screw driver, bottle opener and can opener. Has a stag handle, with ring for attaching to your key chain.

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An inexpensive, sturdy knife, built to stand constant use. Stag handle, one large and one small blade, both made from the best Wardlow English steel, with keen edges. It is lined with brass, and has nickel silver bolsters. A splendid knife at our special bargain price of 69c.

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10 In 1

These wrenches come with five nickel plated end wrenches, that, with the aid of the thumb bolt in the centre will fit ten size nuts. You'll find them compact and convenient, ready for any job, when you want them. 89c Per Set.

STURDY ELECTRIC

MOTOR

99c

You'll find this a strong, sturdy, two terminal electric motor, just the thing for operating light running models and electrical toys. Can be run with one or more dry or wet cell batteries, depending upon the power desired.

Novelty Knife and Bottle Opener 98c

This knife is bound to appeal to the men. The handle is in the shape of a leg, with the shoe end forming a bottle opener. The two fine steel blades open easily, and fit back in the handle when not in use.

Genuine CAMERA

EASTMAN BROWNIE.

$2.86

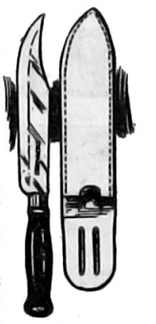
Makes pictures 1½x2½. Is accurate, reliable, efficient and economical to operate. Anybody can make good pictures with it. Has the automatic shutter for snapshots and time exposures. Carefully tested lens and view finders, for vertical and horizontal exposures. These simple and reliable box cameras have stood the test of years and proved a delight to all who have used them.

Complete PRINTING PRESS

$1.50

Every man and boy will find this printing press both useful and instructive. It will print cards, tags, envelopes and announcements. It is made of cast iron; rubber type, cards, ink bronze tweezers and full instructions come with every press and any child who can read can operate it.

HUNTING KNIFE 60c



A great knife for hunting, camping, fishing and all sorts of outdoor work. It comes with a 4-inch heavy steel blade, finely tempered, with ebonized handle, fitted to your grasp. Every knife comes in a genuine leather sheath, with slits in the end through which to slip your belt.

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Shines in the Dark

The only cheap thing about this watch is the price, for you'll find it the all-round handiest timekeeper imaginable. It has the luminous dial that makes it easy to see the time, no matter how dark the night, and a nickel-plated case that will stand the hardest sort of usage. It is fully guaranteed, of course.

$2.75

Pocket Flashlight 39c

Very Special

A flashlight that fits in your vest pocket, all ready for service, when you need a good, clear light. Comes with nickel plated case, equipped with a very bright bulb and a 2-cell battery. The price of 39c is a very special one—for this occasion.

GIANT RAY

FLASHLIGHT

Very Powerful

This is a genuine Tungsten flashlight, five inches long, with a powerful light, in a lightweight, vulcanized fibre case. It flashes on with a pressure of the button and will stay lighted by using the slide switch with which it is equipped. Carefully packed, complete for 99c

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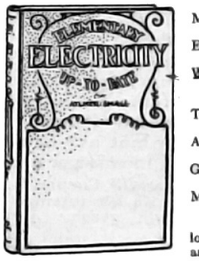
With the Help of one of these Books

$1.00



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- Elementary Electricity.
- Wireless Telegraph and Telephone Handbook.
- Telegraphy Self Taught.
- Automobile Handbook.
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- Machine Shop Practice.

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Great Fun

Turn the handle, look through the slot and see the moving pictures. No end to the amusement it will furnish. Great fun showing these moving pictures to your friends. Price, 29c.

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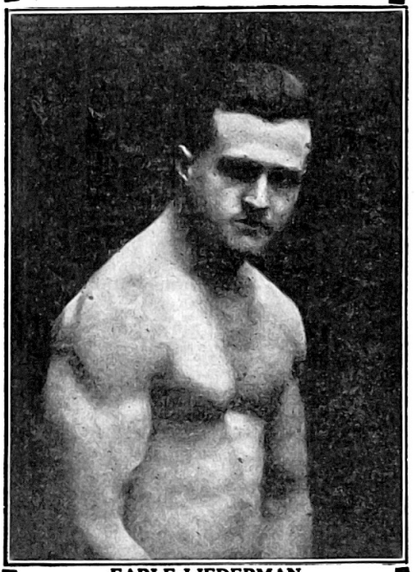
A Powerful Physique!



EARLE LIEDERMAN
The Acme of Physical Perfection

A 48 inch chest and 16½ inch biceps!

I HAVE THEM. HAVE YOU?

Hundreds of my pupils have obtained these measurements, and many of my pupils have exceeded them.

Why not let me do the same for you?

My methods never fail to produce results quickly.

I BEGIN WHERE OTHERS LEAVE OFF.
I PRACTICE WHAT I PREACH.

MY NEW BOOK
"MUSCULAR DEVELOPMENT"
will explain all about my system and will interest you.

It is illustrated with 20 full-page photographs of myself and of some of the finest developed atheletes whom I have trained. If you have not as yet read this book by all means get a copy.

Simply Tear Off Coupon Below and mail to me with 10c (stamps or coin) and you will receive your copy promptly.

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Dept. 215, 203 Broadway, New York City

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DO IT NOW before you forget it

EARLE E. LIEDERMAN,
Dept. 215, 203 Broadway, N.Y. City.

Dear Sir:—I enclose herewith 10c for which you are to send me, without any obligation on my part whatever, a copy of your latest book "Muscular Development." (Please write plainly.)

Name .....

Street .....

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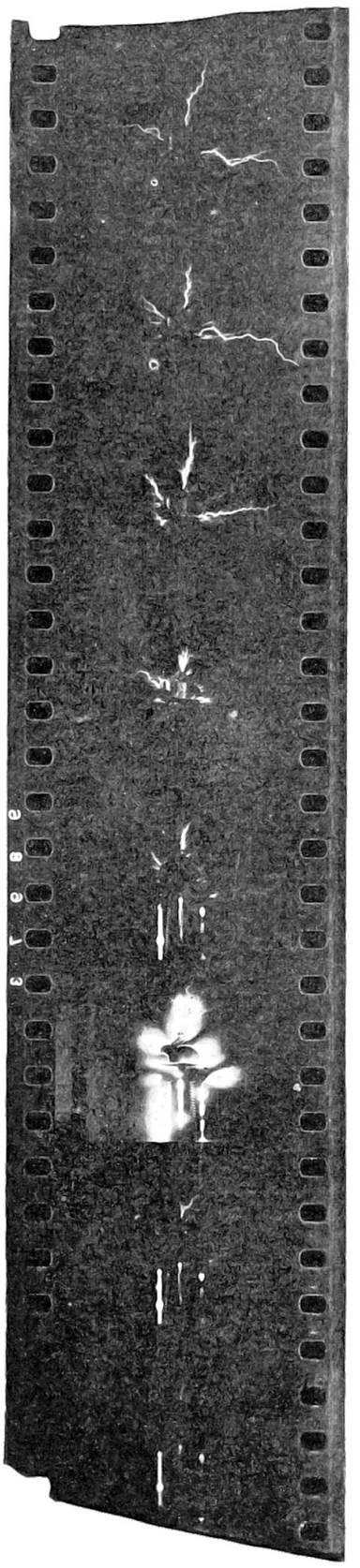
El. Ex. Dec., 1919

HOW DID IT WORK?



This is a Portion of the Film of the Famous Rabbit Described in Our November Issue Who Stood Half a Million Volts, Never Batting an Eye-Lash. Can You Explain This Strange Film? The Editor Will Pay $20.00 for the Best Answer.

Turn to page 633 of our November issue. We told you last month how we electrified a rabbit with 500,000 volts, and how he never batted an eye-lash. Well, sir, the Gaumont Film people who got wind that we were pulling off a stunt were duly on hand with their trusted film cameras and while we made the experiment, the operator cranked away merrily. Of course, we wanted to see what the film looked like and we had our wish. The very mysterious sample slightly enlarged from the original film is printed along side here. At first we were somewhat puzzled and could not quite make it out how the long streamers after the third picture died away into a mere brush and in the fourth picture had almost entirely vanished only to bloom forth in a wonderful corona effect, showing the rabbit very plainly, in the sixth picture. In the seventh and eighth, however, nothing can be seen. Now what do you think happened?

500,000 volts at 20 kilowatts with a frequency of 200,000 was used in the film printed here, which is absolutely authentic. **We will pay $20.00 for the best answer explaining this phenomenon.** Anyone familiar with alternating current should have little trouble in solving the problem. The contest is open to all and will close promptly on February 1st, 1920. Not more than 300 words should be used. Answers will be publisht in our March issue. Address all replies to Rabbit Editor, care of this publication.

RADIO PROTECTION FOR CAMERON.

Citizens of Cameron parish are asking the government to locate a wireless station there, so that storm warnings may be given and farmers may have a chance to give whatever protection they can to their crops.

Cameron is an outpost of Louisiana for Gulf storms, and has suffered severe losses half a dozen times in the past 20 years. It has no railroads, no telegraph or telephone lines to the coast on account of the expense and difficulties of construction across the lowlands, and no method of receiving warnings.

The people of Cameron are industrious and enterprising. They have voted a heavy tax on themselves to construct roads. They have fertile lands which will produce valuable crops. As one of the storm outposts, the Weather Bureau needs to be in touch with Cameron, for the protection of the rest of the country.

Science in Slang—Juicing the Jazz Wagon

(*Continued from page* 785)

"The big idea is that when the piston reaches the proper point in the cylinder chamber the contact is made which closes the circuit that sets up a magnetic flux in the core of the coil, that attracts the vibrator arm and breaks the circuit and sets up an inductive reactive flow in the secondary, which breaks down the resistance—being the weakest place—between the points of the electrodes on the spark plug, which in turn ignites the gas in the chamber and causes the explosion that turns the motor over, that finally takes the joy rider to the court house or Police Headquarters. Whoof!

"Give 'em air boys"—this from Bender—"his carbureter leaks!"

"Such guys as Atwater-Kent have deviated from the old trodden paths and have rigged up an apparatus that is worked

(*Continued on page* 800)

AMPLIFY YOUR RADIO SIGNALS

ONE of the greatest drawbacks since the invention of wireless telegraphy is the receiving of weak signals at the receiving station. Many devices were proposed to improve this condition, but without success, on account of the mechanical difficulties encountered in these amplifying devices.

However, this was recently solved by the introduction of an exceedingly sensitive microphone transmitter, which is known to detect sound waves with great accuracy and magnify them through an intermediate telephone circuit.

By the employment of the new DETECTAGRAPH-TRANSMITTER, the amateur can amplify the radio signals to such an intensity that he can hear the signals about his station without the need of the telephone head set.

By the addition of a loud talking telephone he is able to hear the messages many feet away from the instrument. He is also able to demonstrate the operation of his wireless apparatus to his friends.

The super-sensitive DETECTAGRAPH-TRANSMITTER herewith shown is two and three-eighths inches in diameter, five-eighths of an inch thick and weighs less than three ounces. It is the most sensitive sound detecting device ever brought before the public.

The manner in which the amplifying process is attained is by attaching with tape the DETECTAGRAPH-TRANSMITTER to the regular wireless receiver as indicated in the diagram.

SUPER-SENSITIVE **Detectagraph** MICROPHONE DEVICES

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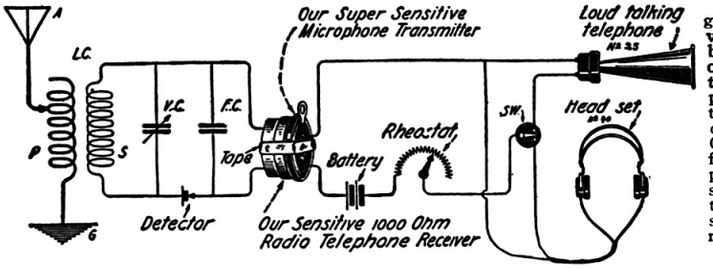
Although prices of raw material and labor have increased greatly in the last four years, we have continued selling our instruments at the pre-war prices, due to the fact that we had a large stock of material on hand. That material is now almost exhausted and we will be compelled to renew our stock at an increase in price, but for a limited time you can still get the benefit of the present low prices.

Our Super-Sensitive Detectagraph Transmitter. Price, $7.00 Complete

Other Uses

Not only is this instrument applicable for amplifying radio signals, but it can be used with equal satisfaction for magnifying other sounds. Phonograph music can be transmitted from one place to another by means of this instrument, and those who are afflicted with deafness will find enormous benefit by using this transmitter.

Our Special No. 25 Loud Talking Receiver Price, $4.50 Complete



It is the greatest device for building your own loud talking telephone, detectagraph and other devices. Can be used for any purpose where a sensitive detecting instrument is required.

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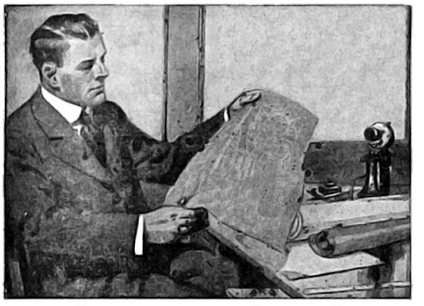

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Science in Slang—Juicing the Jazz Wagon

By Emerson Easterling

(*Continued from page 799*)

like this," continued Jazz. "The contact on the distributor touches for an instant as the movable one passes over the stationary one. This makes a closed circuit. As the circuit is broken by the parting of the contacts the same thing happens that does when the vibrator arm flops up against the core—really, it don't touch the core. That would cause it to stick. A sort of anvil stops it just before it gets there.

"Some time back some bird stumbled onto the idea: that if generators could furnish juice for other purposes, why not stick one on the bus to squirt juice into the plugs? Since then we have had generators, generators, and some more generators, good, bad, and otherwise. In the Ford, Henry incorporates in the fly-wheel an A. C. revolving field generator. He must have run short of junk when he came to this part of his endeavors.

"In the old—I don't think it is the same in the newer types—Overland the self-starter, generator, and fly-wheel is one and the same.

"It was sure some ease on the autoist when the self-commencer came around. It led to other fine features, too. For one thing the electric lights have crowded the old carbide type off the boards.

"To-day we have our gas go-cart all rigged up with an electric self-starter that is operated from a storage battery. The battery is recharged in turn by the generator—sometimes the motor-generator, single unit; sometimes the two unit, one generator to charge the battery, and a motor to start the engine. Then, the lights, horn, cigar lighter, trouble lamp, spot light, and what else the general public care to stick on the layout, are run from the battery—and from the motor when it is running."

"What is this high frequency spark stuff I heard about?" spoke up Bender.

"It is some of James E. Seeley's and Lodge Brothers' ravings. It is just the employing of high frequency currents, like Nick Tesla has fingered around with, for the spark. The advantage is that the spark energy increases with the gas pressure—opposite from that of the other type—and carbon does not bother the ignition, as the spark is of short duration and the flash is not choked up by carbon.

"But getting back to magnetos—they are alternating current generators for the ignition. There are two kinds, low and high tension. The low tension is virtually an alternating current dynamo, and the high tension is a dynamo and step-up in one. The Bosch is one of the best—and it is not *bosh* either."

At that point the engine began to purr—like an angry sewing machine. Conversation somewhat dies away—especially on the part of the chauffeur. But Stokes had gas engines on the brain:

"You know the stationary engines that spat and spit and then hit once in a while? It is an automatic spark affair that is operated by the governor that causes that. When the engine attains a certain speed the governor cut-out stops the ignition. If it wasn't for that the thing would do the Bolshevik ———"

"And don't forget the electrically gear shifted and braked cars," interrupted Bender, "The kind where an electro-magnet jerks 'er from high to me'jum, an' so fort' —an' th' electro-magnetical tire burners—"

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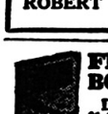

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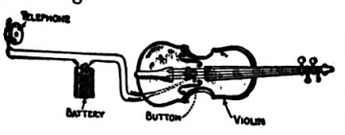
MOST SENSITIVE MICROPHONE

YOU can easily make a highly sensitive detectophone by using a Skinderviken Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument! It's very simple, too, and inexpensive.

FOR $1.00

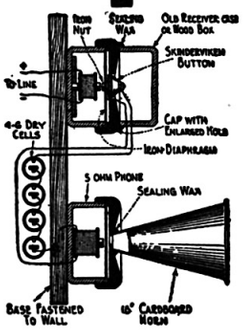
You can install an outfit in your home and hear the conversation being held all over the house. You can connect up different rooms of a hotel. *This outfit was used by secret service operatives during the War. It is being used on the stage.*

Actual size.

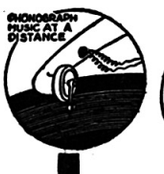


So much for its commercial adaptations! *You* can procure apparatus of the same type.

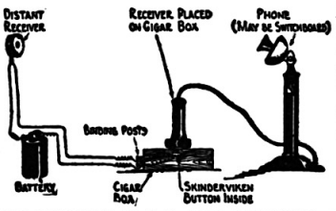
One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitiveness. You can place it in any position you like. It is the greatest invention in micro-phones and has won recommendations from men of high standing in the scientific world. It is being used all over the world. You can mount it most anywhere. Card board boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons cannot be seen by any one in the room as they are so small and light. Only a small brass nut is exposed to the view.



Full directions for connecting up the button for use as a detectophone are given in booklet which is sent with each button.

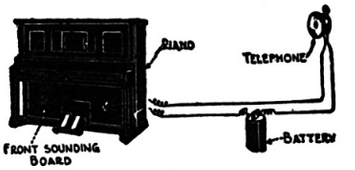


The only instruments needed to complete a detectophone outfit, in addition to a Skinderviken Transmitter Button are a receiver, battery, and, if desired, an induction coil.



AMONG electrical experimenters the button has created a sensation. It is not uncommon to receive unsolicited letters like these: "I received transmitter button today and I wish to inform you that it works great and is *the best I have ever seen or heard of for the price.* I will certainly recommend it to my friends. I wish to thank you for your good service."

"I have been using one of these transmitter buttons, and it has proved to be worth more than its value in my experimenting." "I received one (Transmitter Button) some time ago, and they are just O. K. for experimenting." "I have been using one of these transmitter buttons for experimental work and it certainly lives up to all you say for it *and then some.*"

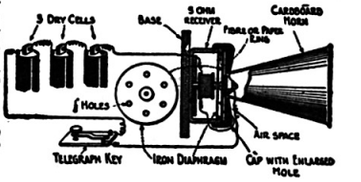


Mr. H. Gernsback, editor of this magazine, who is the dean of electrical experimenters, said: "In the writer's opinion, obtained by actual elaborate tests, the Skinderviken Transmitter Button is probably the most efficient device of its kind on market today, due to its simplicity and other outstanding features. Should have a great future."

The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted.

The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.

We have the utmost faith in this transmitter button. We guarantee satisfactory service or we will refund the purchase price. Boys —Young and old—send in a dollar bill RIGHT NOW! You can't lose. If you're not satisfied, you receive your dollar back. Isn't that fair?



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Thomas A. Edison Speaks to You

By H. Gernsback

(*Continued from page* 750)

few years he has worked more in the chemical laboratory than in any of the others, which are located in different buildings about the great Edison works.

I MEET THE GREAT INVENTOR.

Together we entered the laboratory, the first impression being mostly green fumes. A half dozen of Mr. Edison's assistants were to be seen busily engaged in performing various chemical experiments under the direction of their chief. Mr. Edison himself was nowhere to be seen. Advancing to the rear of the laboratory, I finally discovered Mr. Edison sitting at a little table busily engaged in writing notes upon a yellow pad, using a small pencil. To the right of Mr. Edison on the table was a big chemical dish containing some green solution, presumably copper nitrate. The table, which was rather small, measured perhaps four feet in length by three feet in width. Mr. Edison was seated on a simple wooden chair. Altho the inventor is 73 years old at the present time, I was surprised at his vigorousness and apparent strength. The first impression at close quarters is a kindly face of ruddy complexion, from which peer two light blue-gray eyes of unusual intelligence. There is an enormous broad forehead, over which falls some silver white hair, giving the characteristic Edison curl. The jaw as well as the ears are well formed, both denoting character and a strong will. Like all great men, Edison has a big and massive nose, which denotes the thinker and philosopher. The lips are rather thin, around which a smile is constantly hovering.

Mr. Edison rose and we shook hands. I was startled somewhat, for I expected a large, hard hand. On the contrary it was as small and soft as a woman's hand, and white except for green stains upon it caused by chemicals. There is perhaps no more famous right hand in the world than Edison's. *If the world were called upon to make an inventory of what Mr. Edison's hands have actually wrought in enriching this planet, there would not be gold enough to pay him.* This is not a mere figure of speech or written in order to make this review grandiloquent. It is the unvarnished truth, as anyone with a clear mind and a pencil can easily figure out to his satisfaction. There certainly has never been one man since the dawn of history who has contributed so much to the world's progress as has Mr. Edison. While of course the mind is supreme, Mr. Edison's hands are the tools that achieved his success, and that is why I place so much stress upon this phase.

Mr. Edison spoke and welcomed me—a curiously high-pitched voice, unusual for one who has never heard it, but characteristic of the famous man.

MR. EDISON ANSWERS SOME IMPORTANT QUESTIONS.

Mr. Edison in late years has become hard of hearing, and it is necessary to speak quite loud in order that he may understand you. There being no second chair around, and Mr. Edison having seated himself again, I leaned against the laboratory table, being careful not to sit in the chemical dish, and taking other precautions not to disturb anything. After a few pleasant remarks on both sides, I immediately launched into the object of my visit, namely, to put up to Mr. Edison certain questions which had been in my mind, and which I knew would be of great interest to our rising generation and the world at large. I said to Mr. Edison:

(*Continued on page* 804)

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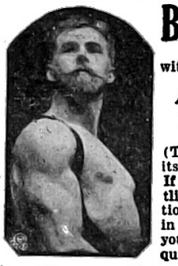

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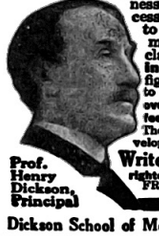

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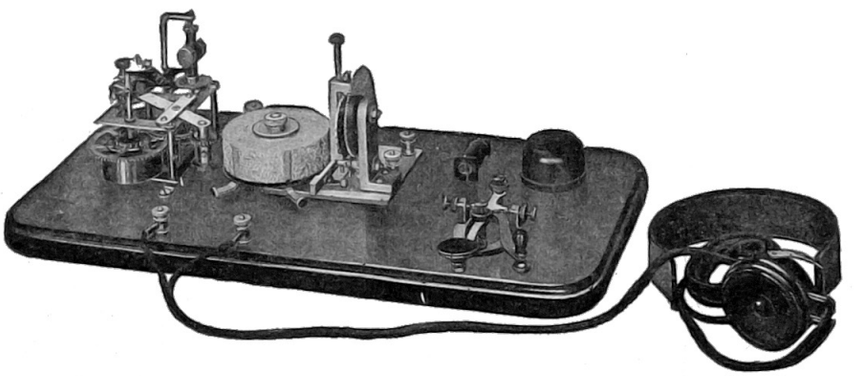

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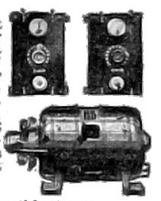
CHOOSE THE SIZE YOU NEED

HB 500-Watt Charger
Recharges 1 to 8 6-volt batteries or their equivalent at a time. Charger is 27 in. long, 26 in. high, weighs 250 lbs. Furnished complete with clear, black, electrical slate switchboard, with mountings of ammeter, field rheostat, voltage lamp, two controlling switches. A big money-maker for a small battery business.

$15 Cash, Balance on easy monthly terms



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Recharges 1 to 16 6-volt batteries at once or their equivalent in 12 or 24-volt batteries. Motor 1 KW capacity. Operates on 2 or 3 phase current only. Furnished complete with 2 independent charging panels, each with a capacity of 8 batteries. A splendid machine for any live, energetic garage owner wishing to get big profits.

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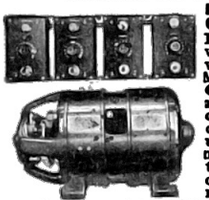

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Your Name .....
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Thomas A. Edison Speaks to You

By H. Gernsback

(*Continued from page* 802)

"Do you believe that the young man who embarks on his electrical studies today, has the same chances and opportunities which you had at the beginning of your career?"

Mr. Edison was very emphatic when he replied: "He has far greater opportunities than I had—infinitely more. There is absolutely no comparison to be made, for the world has grown larger, and therefore the opportunities have multiplied."

This prompted my second question: "In what branch of electricity, in your opinion, can the young man of today accomplish most—where is he most desired?"

Mr. Edison looked squarely at me and said: "There are thousands of men wanted in every branch of electrical engineering and hundreds of new branches based on new discoveries are being created continuously. The field is being enlarged every day and keeps growing. It would be difficult to pick out any one branch, since all are still in their infancy, and all have wonderful futures."

My next question was: "What training should the young man undergo? Should he acquire practical experience first in the shop or laboratory; or should he take a correspondence course or go to college; or all two or three?"

After a few seconds reflection, Mr. Edison replied: "I think one of the correspondence schools at Scranton, Pa., is the more available for most young men. After passing an examination, I think he should specialize in one branch and study it real hard. Then he should get busy and get a position. Any boy can be a success, providing he is willing to pay the price, which is continuous hard work. The trouble with a large number of young men today who are given positions is that they refuse to pay the price, and thus become a drag on the industry. Our young men today do not wish to work as much and as hard as they did when I was a boy. They want shorter hours and more pay, and too many amusements, the same as all workmen do; but I think this condition will be rectified when people come to their senses. It certainly cannot last."

"BE SURE YOUR IDEA WORKS, BEFORE PATENTING IT," SAYS MR. EDISON.

"Mr. Edison, what constructive advice can you give to our young and rising inventors? Is it worth while to patent every idea, or only certain ideas? How can the young inventor differentiate between good ones and bad?"

After a few seconds of meditation Mr. Edison answered: "I suggest that if the young inventor has an idea he had better reduce it to actual practise and be sure that it *works* before applying for a patent. Ideas are easy, but working them into commercial shape is generally a long, tedious and expensive job. After successful operation and the results warrant it, a search of the United States Patent Office should be made to learn if it has not been previously invented or patented by others. Here is where the young inventor will have his greatest disappointment. He will find many a time and, as a matter of fact, in a majority of cases, that the idea has been patented already in one form or another. But disappointments show the salt of the inventor. Only by such disappointments can he triumph finally."

This brought about my next question: "You have patented over one thousand inventions, Mr. Edison. How many of these have been actually worked?"

(*Continued on page* 806)

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Price, $1.50 postpaid.

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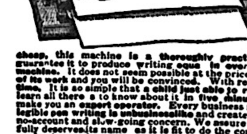

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The Expo loads in daylight with 25 Exposure Films, costing 25c, thus the picture taking part of a whole day's outing may be had for the nominal sum of 25c—One cent a picture. 10 Exposure Films also obtainable. It is simplicity itself to operate. Takes pictures through the stem, where the Rapid Fire Lens is located. The photos (5/8x7/8) may be enlarged to any size.

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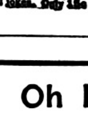

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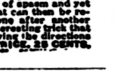

This trick is as effective as it is surprising. The performer hands around the ball for examination, and immediately it is returned to him he seizes it by the tips of his thumbs and fingers and a second ball mysteriously appears. These are held in full view of the audience by the tips of the fingers of the left hand, and even while being placed in position, another ball unexpectedly makes its appearance. Finally the magician apparently suffers from some kind of spasm and yet another ball is the result. The feat can then be reversed, the balls disappearing one after another until none remains. It is a very interesting trick that is quite easily performed by following the directions that accompany the apparatus. PRICE, 25 CENTS.

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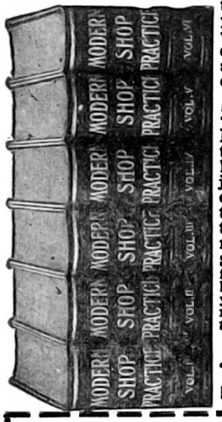

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Thomas A. Edison Speaks to You

By H. Gernsback

(*Continued from page* 804)

MR. EDISON HAS 1400 PATENTS.

Mr. Edison thought for a while—"Of the fourteen hundred patents which I have obtained, about four hundred were actually worked. This figure may be taken as proportionate for inventors. It is seldom that an inventor makes a success of his first invention. Usually he finds that altho he obtains a patent, for some reason or other the idea did not prove to be successful commercially, or could not be exploited otherwise. I have made it a rule in my later years, not to patent anything for which I knew there was no actual demand. Merely collecting patents is a waste of time, money and energy."

This answer of Mr. Edison's was of more than passing interest to me, and at the spur of the moment, I sang out: "Which is your pet invention?"

Mr. Edison smiled broadly, and it seemed to give him much pleasure when he said: "My pet invention I think is the phonograph first—and moving pictures second. Somehow or other these two inventions have taken hold of me more than my other ones, as I have probably spent more time upon them than upon any of the others." This naturally brought me to the next question, which was. "Are your inventions perfected first in your mind or perfected in your models? Or by actual experiments?"

Without hesitation Mr. Edison continued: "I always start out with a definite idea of accomplishing a certain result. I collect all the data possible, both scientific, commercial and otherwise. I then proceed to sketch out every possible and probable way of attaining results and carry it to success by experimenting. In other words, first plan—then act. I usually find that the first model is not at all what I had in mind when I conceived the idea first. Any inventor knows this of course. I have found it necessary for this reason to build many models, and only in the exceptional case is the first model a success."

MR. EDISON TELLS WHAT WORLD MOST NEEDS.

Knowing that Mr. Edison was perhaps one of the greatest authorities on what the world needs most to-day, I asked him: "What inventions does the world need most to-day?"

Becoming reflective, Mr. Edison thought for a few seconds and answered: "Automatic machinery, and systems for the quantity production of one-family houses so cheaply that every man can possess his own home. These two are the world's greatest and most pressing problems today. Take a city like New York, for instance. Conditions there are indescribable. There are too many people in New York at present, and but little new building can be done there. I am in great favor of a law being passed that no additional factories should be built in the city of New York after 1925. This would mean that the housing as well as transportation facilities would not be continually overtaxed as they are now. In other words, the city should be forced to spread out either towards Long Island or to the north."

At this juncture I mentioned to Mr. Edison a plan that was advanced some years ago, whereby it was advocated to build the so-called road house, i. e., a city running thru the country by having a single line of houses built one next to the other with a subway underneath. This would give us a city as well as country at the same time. There would be a sidewalk and roads on each side of the house running continuously without interruption and paralleling the houses.

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"I do not think this idea is very practical," vouchsafed Mr. Edison. "I think it would be too expensive and would make the traveling distances uncomfortable."

While discussing the printers' strike, which just then had started in New York, paralyzing the entire printing industry, I put the question: "What known substitute is there for white print paper when our raw materials give out during the next twenty-five years?"

Mr. Edison's answer was surprising: "Print paper will never give out as long as wood grows in the Amazon and Congo river basins. It is simply a matter of transportation, and that, I believe, will soon be solved, as soon as the world is upon a peace basis once more."

I have always had a pet idea on the subject of *cold light*, so I ventured my next question. "Over 99 per cent of the energy is lost today in useless heat in our incandescent lamps. How near are we to 'cold light,' and do you think it will be invented at all?"

"I think we are slowly advancing in increasing the efficiency of light production," replied the inventor. "Any moment a discovery is liable to be made that will advance the efficiency of our present lighting methods enormously. The time is surely coming when 'cold light' will be a matter of fact. What shape this invention will take, it is impossible to predict today."

"On which of our dormant and unworked sources of energy should our coming generation work most intensely, Mr. Edison?" I asked. "In your mind, is the exploitation of the following sources of energy chimerical or are they within the realm of possibility from the standpoint of modern electrical engineering:

Power derived from the earth's internal heat.

Power derived from the earth's atmosphere.

Power derived from the tides.

Power derived from the sun's heat."

"UTILIZE EARTH'S NATURAL VOLCANIC HEAT," SAYS MR. EDISON.

"Volcanic power to the extent of 5,000 H.P. is utilized already in Italy, and 20,000 H.P. more is being arranged for," explained Mr. Edison. "Italy probably has more in her volcanic regions to work all her machinery and heat every house, carry on every metallurgical process and in fact make coal unnecessary in that country. My impression is that in Nevada and the Yellowstone region there is available volcanic energy greater than that given by all the coal mined in the United States. 'As to solar energy' we are getting there step by step. It is a long and weary road we have to travel, but we are making it slowly. I am an urgent advocate of water power. We are using already too much coal without adequate returns. Water power in the United States is not at all developed as it should be, and I see a great future in its proper development. I have advocated many times that the coal should be burnt at the mine instead of shipt by cars over long hauls. Electric power can be sent much cheaper thru electric wires than over the railroads; in other words, first hauling the coal which is then burnt at the destination."

This prompted my next question: "What are your ideas, Mr. Edison, as to atomic energy?"

Mr. Edison smiled broadly and, with a twinkle in his eye, said: "You know, Mr. Gernsback, I am an inventor, and as such I do not concern myself overmuch with philosophical research, and altho I have my own ideas on atomic energy I am not at present making them public."

My next question was: "What shall America do to prevent Germany from flooding the world with its cheap goods, and winning the war commercially twenty years hence?"

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Here, too, Mr. Edison's reply was surprising as well as illuminating: Germany never has and never will flood the United States with cheap goods or undersell us if we make up our minds to beat her at that game. Out of thousands of articles, she is only efficient in two, to wit: chemical dyes and toys. This is due to our indifference to going into these lines of manufacture. I am happy to note, however, that American manufacturers are beginning to see the light, and are protecting themselves adequately."

We then discust various other subjects, and it soon became apparent that Mr. Edison thought that every prophet is honored save in his own country. Mr. Edison was of the opinion that before the war, and particularly during the war, American inventors had not received their due credit, most of the fame having gone across the water. Mr. Edison felt particularly strong about a recent patent decision, where the honors of the vacuum tube used for radio purposes went to an English inventor. It is an incontrovertible fact that the "Edison effect" was known years before the Fleming valve was discovered, having been publisht in American and foreign scientific papers. Mr. Edison was certainly right in his contention that the honors for the invention of the vacuum tube should go to America, and there seems to be no doubt as to this.

My final question to Mr. Edison was, "What is your hobby, and how do you relax from your work?"

GREAT INVENTOR'S HOBBY IS "EXPERIMENTING."

"Just now my hobby is 'experimenting.' I like experimenting better than anything that I know of. As for my relaxation, I like to camp out in the mountains, which I do every summer. This makes me fit for another winter's hard work."

Mr. Meadowcroft by this time was beginning to look at his watch, which I took for a gentle hint, and shaking hands with Mr. Edison, I took my leave.

While shaking hands I was again impressed with Mr. Edison's hand, and I subsequently made a special request of Mr. Meadowcroft to let me have a photograph of the great inventor's hands for publication. I was much astonished to learn that no photograph of Mr. Edison's hands existed, none having ever been taken, the inventor feeling rather sensitive about this. I had seen many sketches of Mr. Edison's hands, but I only then remembered never having seen an actual photograph. It took several weeks to secure permission from Mr. Edison, but finally the photograph of his hands was taken, and it is here presented to the readers of the ELECTRICAL EXPERIMENTER for the first time.

I also made another discovery, namely, that there was no oil painting in existence of Mr. Edison. True, several of these had been made by certain artists after Mr. Edison had patiently sat for them, but he was more or less displeased with the result, and on one occasion did not hesitate to put his foot thru one of them. After securing Mr. Edison's permission, I charged Mr. Howard V. Brown with the delicate mission of making an oil painting of the famous man. It is reproduced on the front cover of this magazine in full colors. It is the only oil painting in existence of Mr. Edison today, and the inventor, who inspected it, was very much pleased with it, declaring it a perfect likeness.

As I past out of the laboratory I caught a last glimpse of Mr. Edison. He had risen from his chair, making his way to a little room containing delicate scales and apparatus. The tall, white-haired figure, somewhat stooped under its 73 years' load, clad in a duster, bespotted with chemicals, slowly faded out of view into the adjoining room.

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Thresh barley	1 bushel
Separate milk	60 gallons
Churn butter	33 pounds
Groom horses	2
Stuff sausages	200 pounds

Submarines to Salvage Sunken Ships

(*Continued from page* 745)

light projectors, which would be of inestimable service to the divers, while they were engaged on the wreck and also a better supply of air can be supplied them owing to the shorter hose necessary. If it is not desired to submerge the pontoons for this part of the preliminary work in the salvaging operation, it would be economical and feasible to provide a small submarine which can sink to the level at which the wreck was lying, and by providing special air-locks on the submergible, divers can walk right out on the watery bed. It may be mentioned here, that in such a case, and provided the divers do not have to stay away from the submergible too long at one time, that they would not have to be tied fast to it with a rubber air-hose, for there is now available an independent oxygen and air-diving apparatus which can be carried on the diver's back.

HOW THE DIVER GETS OUT UNDER WATER

An interesting problem here arises, and that is—how are we going to get the divers in and out of the pontoon-submersible or any form of sub-sea craft when it is closed and under the surface of the waves? The illustration herewith illustrates one form of air-lock chamber which can be employed for the purpose. With the arrangement delineated the operation of getting out of a submarine by means of this air-lock is as follows:—the diver dons his costume in the inside pontoon quarters, where the crew is lodged. He then passes thru the right-hand water-proof door, into an air-lock chamber, which chamber has its outer door closed, rendering it dry. The cabin compartment door is closed, and the sea-cocks opened and the water allowed to rush into the air-lock chamber. The diver adjusts his oxygen apparatus and prepares to pass thru the outer door when the chamber has become full of water, this door then opening easily. As he passes out into the stair-well, he locates the usual air-hose terminal by means of a red electric light marking its position, and connects it to a valve on the top of his helmet. He tries the air, and ascertaining that everything is all right, he proceeds to climb up the iron ladder to the deck of the pontoon. He is then ready to descend down a steel cable to the scene of the wreck. The air-hose, as he descends, unwinds from a reel placed in a water-tight compartment underneath the stair-well in the manner here illustrated. And here is the way the divers can come back into the pontoon for lunch. They climb up the steel cable or ladder which is sometimes used, and once they arrive in the stair-well in the pontoon, they disconnect the air-hose and the water is prevented from entering the diver's suit by means of automatic valves in the helmets. The diver then walks into the air-lock chamber and closes the outer door. By

(*Continued on page* 819)

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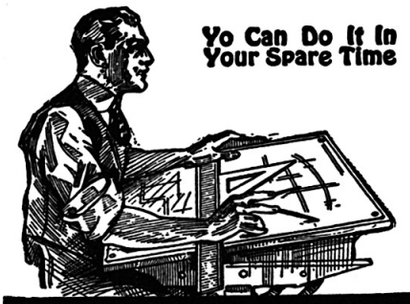

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Statisticians say that ninety per cent. of all the electricity supplied by central generating stations is alternating current.

40 M. P. H. PONY DIRIGIBLE COMING.

The advent of a new kind of aircraft called the "Pony Dirigible" was announced recently at Cleveland, Ohio, at the reception given for the special commission of the Aero Club of America and the Aerial League of America which is organizing the first aerial derby around the world.

Mr. Upson said an Akron company was about to put on the market a small two-passenger dirigible balloon equipt with a forty-horse power engine which will attain a speed of forty miles an hour and will be so easy to pilot that anybody can do so on short instruction.

Mysteries of Stage-craft

By H. Winfield Secor

(*Continued from page 752*)

one of the three platforms can be moved either into or out of its position before the foot-lights.

WATER, SNOW AND RAIN EFFECTS.

The "Disappearing Divers" have long proven a complete mystery to most patrons of theaters such as the New York Hippodrome. In such productions, as the reader probably is aware, a considerable mystery is evolved by having several people (sometimes as many as 20 or 30) dive into a large water-filled tank and they disappear completely, not coming up again for a space of twenty minutes or more. There are several ways of accomplishing this trick, and two of them which have been successfully adopted are illustrated herewith at figure 4. The first is that utilizing *diving bells.* These diving bells, one or more of which may be used as required, according to the size of the tank, are made of steel and must be air-tight. They act on the same principle that when you place a drinking glass or cup into a basin of water, the water will not rise all the way up in the glass, due to the compression of air within the glass. Thus, when the divers plunge into the water, they are enabled to see the position of the bell, owing to the fact that it has electric lights inside of it, which lights up the water at the bottom of the tank, and indicates the hulk of the diving bell very plainly. When they reach the bottom of the tank, they swim towards the bell and pull themselves up inside of it, under the rim. Comprest air is forced into the bell thru a pipe in order to keep the

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water at as low a level as possible within it, and where a number of swimmers have to remain in the bell for any appreciable time, proper air outlet and inlet pipes have to be provided, so that an exchange of air is made possible within the bell chamber. For a shorter period, and when not many people breathe the air within the bell, they can get along without fresh air being supplied. With fresh air under pressure being pumped into the bell, some of the air and its products, such as carbon dioxide gas, will bubble out thru the water and thus help to refresh the atmosphere within it. Mirrors are arranged inside the bell so that the fair swimmers may adjust their hair and clothes.

Another stunt for accomplishing the "Disappearing Diver" trick is that employing one or more tubes leading out from the tank to a place on the rear of the stage. The position of the tube running into the tank is either known to the swimmers, or in large tanks they are lighted up by blind bullseyes or lamps, which only the divers can see, and by holding their breath for a few seconds, they manage to swim for the tube-opening as soon as they dive into the water, up thru which they crawl by means of ribs on the wall of the tube, to the stage-floor level. As is well known, the water in the tube will not rise higher than it is in the tank. When it is time for the divers to appear, they pass down thru the tube and, Wonder of Wonders! they come popping right out of the water as fresh as a daisy. In the case of the diving bell, they simply hold their breath, slip out from under the bell, and swim to the surface of the tank. In one of these productions a Viking ship slowly rose to the surface of the water on which the swimmers, about 20 in number, stood, as the deck eventually cleared the water. Truly a wonderful spectacle! To produce this astonishing display, the ship has wheels running on an inclined track up to the surface of the water. A gripping tackle is provided at the bottom of the tank to pull the ship up at the desired moment. The masts which are quite high are made telescopic and these are raised under the control of one of the men in the diving bells. Then, when the masts have been raised about half-way out of the water, all of the swimmers pop out from under the diving bells, holding their breath and stand on the deck of the good ship "Viking". The captain of this mysterious craft pulls the lever releasing the clutches, and the ship rapidly rises to the surface, the heads of those standing on the deck appearing thru the water first, the water running from their clothes and shoulders as they emerge from the watery depths.

At figure 5 is shown an interesting snow scene in the production of "Way Down East", the play that has successfully "held the boards" for many years. The snow in practically every show is produced in the form of small bits of cut up white paper. The "snow" is spilled down from the fly gallery 40 feet above the stage, or in some cases, it is simply thrown from the stage floor level by some other means. At figure 5 it is shown being dumped from trays along the fly galleries and as it reached a point several feet above the stage floor, it was caught by the breeze from powerful electric fans placed between the wings on either side of the stage, which caused it to be blown out on the stage in a very realistic manner. At the same time the "wind" noise is caused by the whirring of the fans.

A very realistic rain and river scene with real water was produced several years ago in a traveling or road production, with which the writer had some experience—in fact he had the pleasure of "controlling the rain," and that is some pleasure, "Believe me, Xantippe!" Well, to cut short the suspense, the rain was made by simply having a pipe extend across the front of

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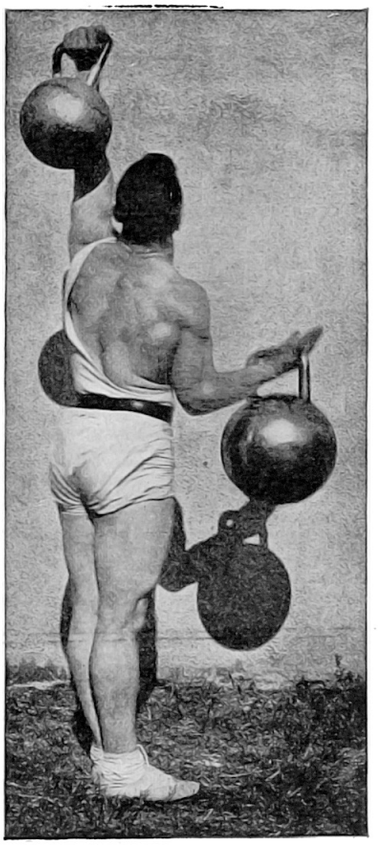

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the stage, and which pipe was perforated with several dozen small holes. This rain-making pipe was then connected with a hose to a water pipe at one of the fly galleries, where the person controlling the rain is standing. When he gets the cue from the stage manager, to "let 'er go", he immediately opens the valve and the water descends from the openings, dropping to the tank or rubber apron below, in the form of "sure enough, honest-to-goodness" rain! This forms a sheet of rain and for most purposes gives a very satisfactory effect.

This show had a most exciting water scene, and the method for staging it was one of the most wonderful that the writer has ever come in contact with. The production carried a large flexible rubber tank, the full length of the stage and about one foot deep, which would thus hold enough water to float row-boats or a small launch. In the center of the tank there was a deeper pocket, measuring about 10x7 feet which projected down into a wooden frame under the stage, and into which the hero proceeded to dive in the second act in order to save the beautiful blonde heroine. If the "villiun" had felt real interest in, or had been jealous of the affection of the hero for the heroine "off stage", he could move the "phoney" canvas-covered "rock", and if our hero dived he would then make a miscalculation and end by dropping into one foot of water, instead of ten. With this improvised and somewhat shallow tank of water, a very exciting melodrama was "put-on"; the scenery was hung over the sides of the tank so that just the water line appeared to the audience, and in fact no part of the tank whatever. A band of counterfeiters floated up the river in a launch, while the police boat, chasing them, fired several dozen revolver shots thru a phoney machine gun. It was some exciting plot and very realistic.

SUN, MOON AND STAR EFFECTS ON THE STAGE.

In the "Garden of Allah", one of the most pretentious scenic productions put on in New York in several years, there was a very realistic *desert sand storm.* Real sand was used in producing this storm scene and as shown in figure 7, the sand was caused to be blown upward, and then caused in turn to whirl in eddies by means of electric blowers placed at the proper points about the stage. These electric blowers were camouflaged under small stage props, which were colored and arranged to fade in with the sand of the desert. The twinkling stars were created by a large number of tiny electric lights being hung against a dark blue background, the various circuits of lamps being rapidly switched on and off by an automatic flasher. As the lights were staggered and placed in an irregular formation, and as the lights in different levels were alternately illuminated and extinguished, no regular coherence of effect could be gathered and the audience was thus charmed with the display.

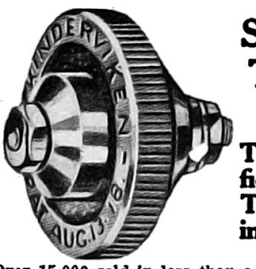
At figure 8 is shown an arrangement in use for producing the best type of moon or sun-rise, or also the setting of the moon or sun. In the ordinary production no attention is paid to the well known fact that the moon or sun is always larger when down near the horizon, growing smaller in diameter as it mounts to the heavens. The moon effect, for instance, is produced in the following manner:—a powerful lamp, such as 1,000-watt incandescent gas-filled bulb, is placed in a light-tight box. In the front of this box there is arranged a slide in which colored screens can be placed to give a yellow or other tint to the light, and across this opening there is mounted an iris diafram, similar to that used in camera shutters. This diafram is fitted with a lever extended from the side of the box, and from which a cord depends downward. The box is now carefully elevated by means of a rope, or two ropes, such as will allow

it to be pulled upward in a slow manner. At the same time the operator controlling the moon-rise slowly closes the iris diafram, causing the "moon" to gradually grow small as it mounts up from the horizon painted on the scene.

Figure 9 shows how *open fire place* effects have been produced as well as *blazing fire* from other stage mountings. It is seldom that a real fire is used on the stage, both because it is not necessary and also because it is somewhat dangerous where there is so much canvas scenery about, altho these are fire-proofed as best they can be. The *flame* of such fires is produced by thin red silk ribbon or else by pieces of red silk. An electric blower or fan is so placed as to blow these silk strands and cause them to resemble a flame, especially when lighted from behind or beneath by means of red lamps. Figure 9 shows also how windows in small houses, appearing in the back of the settings in certain scenes, are lighted up. In a recent Belasco production, "Dark Rosaleen", all such stage effects as this are very carefully worked out so as to produce an exact and true scenic setting. The electric lamps for lighting up the windows are shielded by a canvas flap in the manner shown, so that no light flashes up above the frame of the house or reflects back onto the scenery, which would, of course, spoil the scene. The windows are made of celluloid or similar material, either colored or painted. Where scenery glass is required, and unless some desperado is to do the "business" of jumping thru a window to the accompaniment of crashing glass, then ordinary window screening is used. In one of these large windows containing about 20 openings, it was surprising to note how well this screen resembled glass, and moreover it had been painted around the edges so as to give the effect of a long accumulation of dust and dirt. Flags are often used in spectacular productions, dramas, etc., and of course the best effect is created by having the flag wave. This is usually done by placing an electric fan near the flag and just behind a piece of scenery so that the fan is out of sight with respect to the audience.

MISCELLANEOUS STAGE TRICKS.

Some of the more elaborate stage productions carry with them a portable electric switch-board of their own, as shown at Fig. 10. One of these switch-boards which the writer recently saw, contained a whole battery of dimmers (rheostats) for controlling the lamps of various border and spot lights—this portable switch-board rolling about on wheels, and being connected to the electric supply mains by means of a flexible rubber covered cable. At Fig. 10, there is also shown the three stage revolving spot-light platform which is used in some of the spectacular productions produced on large stages. The spot-light operators are located on the different stages



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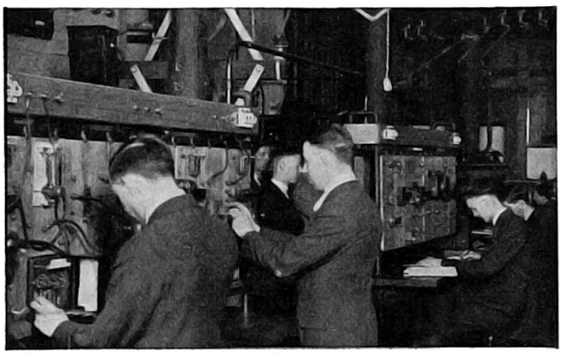

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of the platform which has a total height of thirty feet or more. Flexible rubber covered cables supply current to the spot-lights from the stage floor pocket. Arc lamps for stage spot lights are rapidly going into disfavor and the new 500- and 1,000-watt gas-filled tungsten lamps are taking their place. At Fig. 11, there is shown a motor-driven scene raising and lowering mechanism installed in one of the New York theaters. All large theaters today have what is known as a grid-iron, and fly gallery above the stage, the height of the grid-iron being about 80 feet above the stage floor. Large drops, ceilings of rooms, house roofs, and all such scenic effects are hoisted by means of ropes and suspended from the grid-iron, so that they hang about 40 feet above the stage, and just over the particular setting which happens to be in use. Sometimes 40 or 50 scenes may be seen hanging from the grid-iron and above the Actor's heads. In the usual theater, these scenes are correctly balanced by heavy iron weights, so that they can be raised and lowered by one man, without undue exertion. At this particular theater, however, an electric motor drives the shaft which runs along one side of the fly gallery. The ropes coming down from the various pulleys up on the grid-iron, and by means of which the scenes are raised, pass down to this motor driven shaft, each rope being secured to a suitable winding drum. By means of a clutch attached to each rope hoisting drum, it is possible to quickly raise or lower any scene desired, the electric motor doing all the work. By throwing in several clutches at once, as many as four or five scenes can be raised simultaneously. When the scene is raised to its proper height and in order to prevent breaking the ropes and dropping the scene, an automatic electric cut-off is fitted to the hoisting ropes which stops the motor if the scene is raised too far up.

SCENE PAINTING

Little is known regarding the life of the *Scene Painter.* Painting scenery is a profession by itself, and naturally the first requisite is that the scene painter shall be an artist. Also, to be successful, he should be an engineer, an architect, and a thoro student of electric lighting effects, especially with respect to colors. The brilliant colors which are sometimes seen in stage productions are very flat and commonplace looking when seen in daylight. All of these things the scene painter must take into consideration constantly, while he is painting the scene.

Figure 12 shows a scene painting bridge at a large New York playhouse. The colors are made up in large quantities in dishes and bowls placed on long tables along the bridge,—this bridge being 40 feet above the stage floor and having no rails on it. The canvas on which the scene is to be painted is mounted on a large and fairly heavy wooden frame, which is swung on ropes from the grid-iron 40 feet above the bridge. By means of ropes on either end of the bridge, the scene painters can raise or lower the canvas as desired. Large scenes measure about 85 feet long by 40 feet high. All of the scenes, no matter of what building or other view they may represent, are invariably laid out on the canvas with chalk lines and scaled off from a miniature scene, in much the same manner as a house builder constructs a house from the architect's plans. Room scenes where elaborate sets are used, are sometimes provided with heavy wooden doors and framed windows; these are also constructed at first in miniature, even down to the tables and chairs and the vases and clock on the mantle. These parts are scaled off and constructed to exact detail and size by the stage carpenters from the scenic artist's master model. These models are generally but a few feet in length and some of the miniature views, from which back

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drop scenes like the one shown at Fig. 12, are painted, are no larger than an 8x10 inch photo. Photos are often used to paint scenes from or to help the artist in depicting correctly certain foreign views, such as Chinese buildings, et cetera.

Stage scenes are painted in strips, i.e., when several painters are working upon the bridge, they all work across the canvas at an average height of say 6 feet. After this 6 foot strip across the canvas has been painted, the frame is lowered this amount, and a new six foot strip across the scene is painted, and so on, until the whole canvas is finished.

A new departure in scene painting is that involving the use of a large *air brush* which is shown at Fig. 12. One of the most successful scenic artists who was the first to make use of the air-brush in painting scenes on such a large scale as this, is Mr. D. M. Aiken of New York. The beautiful and truly magnificent color effects known only to the air-brush artist, have been available for a number of years in connection with small photograph retouching; and now that these wonderously beautiful color creations are available to the stage scene painter, we can expect to see some extraordinarily entrancing stage settings.

New York Electrical Show

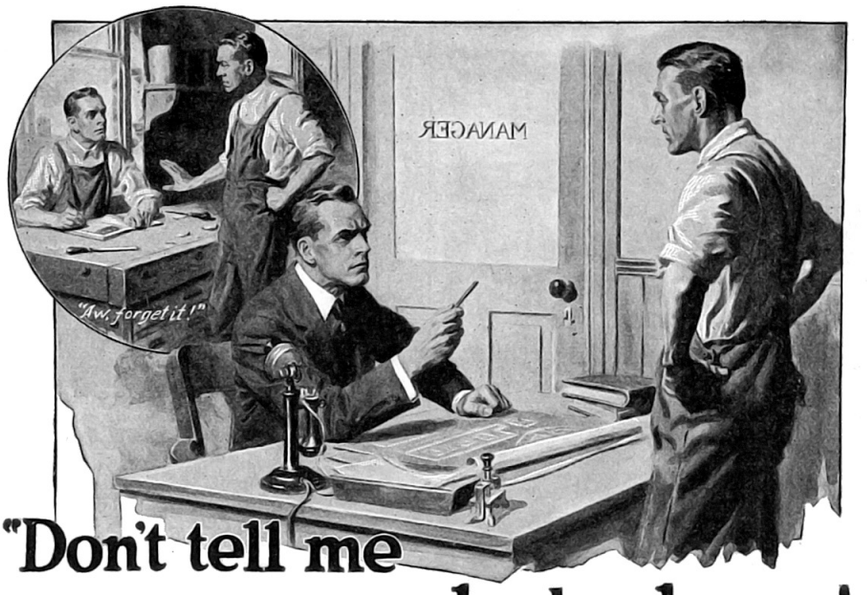
(*Continued on page 761*)

brush at the front of it, which was rubbing the soap suds and water thru the rug faster than Aunt Jemima ever thought of doing it in her palmiest house-cleaning days. The gentleman in charge of this exhibit asked us to come right up and inspect the operation, and we did. The rug was quite dirty where the machine had started, but the path over which it had slowly past and washed, as well as dried, was astonishingly clean. Now, thanks to this invention, rugs and carpets in large hotels, theaters and dwelling houses can be cleaned right on the floor *without removal.*

All kinds of electrical kitchen utensils were exhibited, some of them in actual operation, from electric toaster up to gigantic five horse power dough mixers in the electric bakery, which cuft and swatted the 100-pound batch or bread dough, as if it had been only as big as a finished loaf of bread. The bread was baked in this bakery in electric ovens and served with "current" jelly to the hungry crowd. The bread was good, we tried it, and we did not feel any ill effects from the "current" jelly, altho we did expect a shock or two. See Figure 5. The new electric reflection heaters, composed of a small electrically heated coil placed in the focus of a copper reflector, were displayed at many spots. You can feel the blast of heat reflected from these, even when the heaters are at a distance of 10 to 15 feet, whenever you pass one of these heaters. Shown at Fig. 6.

One of the electric washing machines of particular efficiency, and which appeared to be extraordinarily "full of pep," is that illustrated at Fig. 7. This was called the "Locomotive" Washer. The glass tank rushed back and forth with startling velocity, forcing the hot soapy water *thru the clothes* with a natural pressure and in a way which would not injure them.

Passing on, we finally arrived at the corner where the electrical "Docs" held forth. The air in this region was surcharged with high tension electricity as the powerful Coolidge X-ray tubes shot forth their penetrating rays, while now and then a crashing spark jumped across a one-foot gap on the transformer exciting the tube, not to mention the crashing of several dozen small high-frequency machines, which were being



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demonstrated by experts for the benefit of a "long-suffering" public. This exhibit also included electric lamp heat baths in the form of cabinets of various shapes and sizes fitted with mirrors and several dozen high candle-power lamps inside of them, as well as nifty, small-size X-ray outfits for dentists. You know, now-a-days, they say a patient knows as much about his tooth as a dentist does, unless the "Doc" has an honest-to-goodness X-ray machine and can examine the "interior" of your roots and jaw bone to see whether or not you have any tumors or abcesses sprouting there. So, this year, more than ever before, everybody that was up on the technique of modern denistry, was particularly interested in this display. One of the special tooth-jerkers' X-ray tooth analyzers, is illustrated at Fig. 9.

WIRELESS HOLDS SWAY AT THE ELECTRICAL SHOW.

At one corner of the radio exhibit we ran into the latest thing in wireless, the radio-goniometer or wireless direction finder. See Fig. 10. This comprises a coil of several turns of wire mounted on a pivoted frame, so that the coil can be turned around to any degree of the compass. The shaft is fitted with a pointer and scale, so that the exact point of the compass to which it points can at once be determined. Thousands of these devices were used during the war to locate enemy wireless stations, when the latter were fired on by our artillery, sometimes when they were many miles away and out of sight. Wireless telephony was demonstrated at the Electrical Show, also, as shown at Fig. 15. Audion bulbs were used in practically all of the wireless instruments exhibited both for transmitting and receiving. A new and interesting "direct current" wireless transmitter, giving a musical note without a rotary converter, was demonstrated.

As before mentioned, a complete electric dairy was exhibited, with several choice cows which were milked with an electric vacuum milker several times a day, for the edification of the cityites, who occasionally manifest the idea that our lacteal products come from so lowly a source as the country roadside milkweed. Some extremely interesting and clever "coin-in-the-slot" dispensing machines were exhibited. The company supplying these machines have made them as nearly human and fool-proof as possible. Not only do these machines dispense everything imaginable—from a "cootie-proof" hair brush to a theater ticket to see a Mary Pickford six-reeler, but they are fitted with one of the most marvelous scientific coin rejectors ever conceived. They are guaranteed to refund your money unless you feed them with guaranteed solid U. S. coin, and this coin must not have any holes in it; no smoothed out edges and no figures or designs missing. Also, the weight must be right, the composition must be right, and the size must be correct. Apparently, this machine has got the eagle-eyed bank cashier backed off the map when it comes to telling a "counterfeit" from a "real" coin. See Fig. 12.

Electric sirens were exhibited (see Fig. 13) in various sizes, some of which can be heard for several miles, and which are used with great success by fire departments. Many electric devices and attachments were shown to aid the seamstress and tailor and a new line of cloth-cutting machines were demonstrated. One of these machines, in the hands of an experienced operator, will cut thru a hundred thicknesses of cloth at once. One style has a motor operated steel wheel which does the cutting, while another larger type has a knife shaped like a razor blade which is oscillated vertically several hundred times per minute. See Fig. 14.

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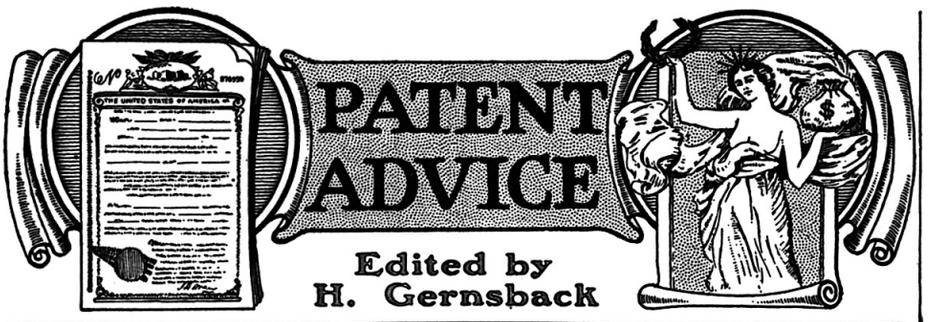


In this Department we publish such matter as is o interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Automatic Non-Leak Oil Can.

(356) L. Scales, Tusla, Okla., asks our advice on an automatic self-closing spout for oil cans. When the bottom is prest, a rod fastened to it opens and closes a plug or valve in the tip of the spout.

A. We have looked over your drawing carefully, showing your suggestion for an automatic oil can, and it would seem to have several good merits, particularly from the fact that no oil can leak out of the can when it may happen to be knocked over or upset. There is only one weak point which you probably have or can overcome in the design or manufacture of this oil can, and that is the small metal bar or pear-shaped plug at the spout of the nozzle, which has to be screwed on to the light rod secured to the bottom. It would seem that after the can had been used for a while, that the wear and tear on the thread, etc., would lower the efficiency of the device, causing it to leak oil when upset, in spite of the attempt made to overcome this objection.

If you can, however, overcome this weak point and provide a sufficiently heavy rod to make the oil can reliable and suitable for constant usage, we believe you have a very good device and one worth applying for a patent on.

Thermometer.

(357) John Schmidt, Long Island, N. Y., writes: "Having read in the current issue of ELECTRICAL EXPERIMENTER of the patent advice you give to readers, I submit to you the following: I have perfected a thermometer constructed by winding a spring made from a certain metal called by some thermostatic steel. The spring is wound, one coil on top of the other, similar to a watch main-spring. A shaft of a predetermined height is soldered to the spring. Next a bearing is fastened to a case of suitable size for the shaft to lay into (the top bearing is merely a hole drilled into the dial of the instrument). The dial is properly calibrated, with which I am thoroly familiar. As you will notice by the sample which I sent you, one side of the metal is nickel, which makes it expand with heat and contract with cold, which in turn rotates the shaft. to the end of which a pointer is fastened. This determines the correct temperature of the room into which it is hung. I have constructed a model which has stood up with any mercury thermometer that I hung along side of it. To my knowledge there is not another instrument built along these lines. Please advise if a patent can be obtained on this invention."

A. To our mind this is a very good idea, and we are inclined to think that a patent can be obtained on this invention. Providing a large temperature range can be had on such a thermometer, we should think that it would be quite a practical instrument and one that would commend itself readily to the public.

Protected Switch.

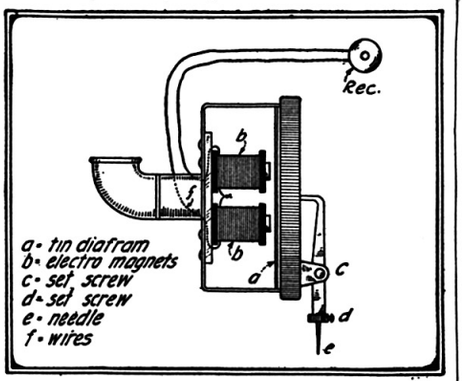
(358) Onni Koskin, Dollar Bay, Mich., says: "It is claimed that a large share of the accidents from electric shock are caused by open knife switches. I think that this could be prevented by insulating all the exposed metal parts, except the contacts with some material such as the enamel used on some electric wires. I would like to know if this idea could be patented."

A. Switches of this kind are in use now. For this reason we do not think that you could obtain a patent.

Electric Recorder and Reproducer.

(359) Marion W. Taylor, Buechel, Ky., submits an idea, shown in the illustration, which works as follows: The recorder and reproducer works as a telephone receiver. A person speaking in a transmitter connected to this instrument causes the vibrator or diafram to vibrate, thus making the impression upon the record. Then, when run over the second time the same will be reproduced in a pair of receivers, this being done by having a direct current between recorder and phones, so that when the diafram vibrates it breaks the lines of magnetic force producing sounds. He wishes to know if this is a patentable feature and if we think that the idea is valuable.

A. This seems to us as a good idea, and we think a patent can be obtained on it, altho we do not see the exact use of the instrument, but, of course, there may be some uses for it, such as for transmitting phonograph music at a distance, etc. You seem to think that it is necessary to have a battery in connection with this device, but this is not necessary, providing the electro-magnets have a steel horseshoe magnet. Then, in that case, no battery is required, as the music or words



from the phonograph would be transmitted "electro-magnetically"; the same as when you take two receivers and connect them together without a battery. This arrangement, as is well known, will then "talk." The coils, however, must be mounted on soft iron pole-pieces, not on the steel magnet frame proper. These pole-pieces or cores are then securely clamped to the steel magnet.

Wireless Device.

(360) W. J. B., Philadelphia, Pa., sends in a description of a design of a new system for wireless telegraphy, and would like to know if a patent could be obtained upon it and, particularly as it requires no aerial, what its advantages are. Several other pertinent questions are asked.

A. We have carefully looked over this invention, but we fail to see how it could possibly work, as no circuit is provided for the secondary discharge of the spark gap; hence we feel certain that it could never work successfully.

Scale Dividers.

(361) Elmer Knitter, Cleveland, Ohio., writes: "I submit herewith a sketch of an idea on which I would like to have your opinion along such

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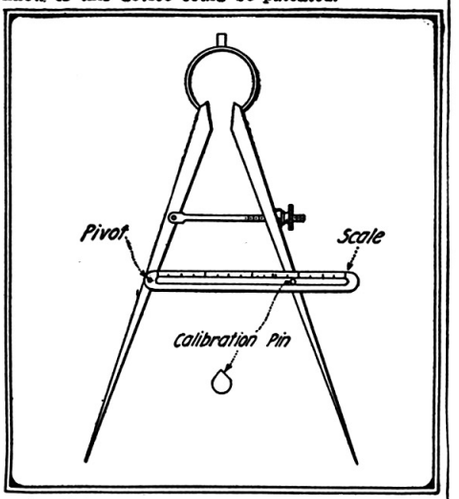
lines as you publish in the ELECTRICAL EXPERIMENTER. The idea contains a provision of a scale on dividers, calipers and similar instruments so as to obtain quicker measurements than we do now, for the simple reason that it does away with the slow method now in use. I would like to know if this device could be patented."



A. This seems like a good idea, altho we think we have seen a similar device once before. Of course, it would be necessary to make the calibrations so that the scale would read in inches for the distance at the end of the dividers, but this, of course, is a mere detail. Our advice is to have a search made in the Patent Office for patentability.

"Perpetual Motion."

(362) Werner Kretschmer, Demarest, N. J., submits a scheme whereby a motor is connected to dynamo with a belt and with wires attached to the brushes. It is first started by an outside source of current, such as a storage battery. The motor then works the dynamo thru the belt and a current is generated in the dynamo. Then the outside circuit is broken and the dynamo supplies the current to run the motor, which, in turn, runs the dynamo. If there is nothing fundamentally wrong with this plan, the apparatus would work indefinitely. Of course, some energy would be lost thru friction and other resistance, but I see no reason why that could not be overcome by using a powerful, yet easy-running dynamo. If this plan were possible, I believe it would do a great deal toward making the electric automobile more of a success. Only a weak current would be needed to start the action.

A. This scheme is just as feasible as lifting oneself up in the air by one's own boot straps. This idea is a favorite one among young inventors, and it crops up every once in a while. The idea, however, is entirely fallacious, as you cannot possibly obtain energy for nothing. Too much energy is lost in friction and other losses, making it impossible for such a scheme to come even near working.

Fly Swatter.

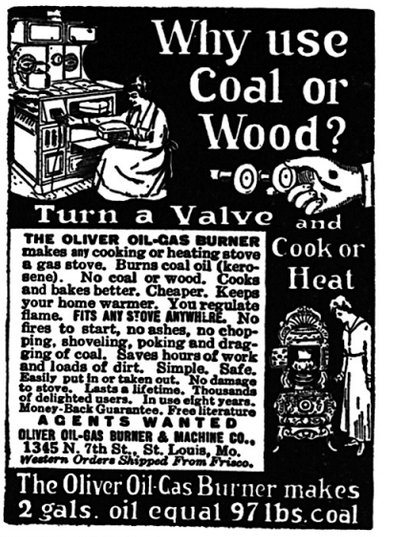
(363) John F. Carlson, Irwin, Pa., sends us a sketch of a new fly swatter, which is made of a piece of screen with a soft rubber frame molded around the edge to protect scratching the furniture, etc. The wooden handle could be cemented into the rubber. He would like to know if a patent can be obtained on this article, and if there is such a swatter on the market.

A. There is nothing new whatsoever in this invention, and you can buy such swatters in many stores handling household goods. They sell for about fifteen or twenty-five cents. It is quite an old idea.

Ignition Device.

(364) Clyde Stewart, Beldenville, Wis., says: "I submit herewith a drawing of a supposed ignition outfit. The drawing is almost self-explanatory. The secondary coil, which could be similar to the one used on wireless spark coils is fastened firmly to the cam shaft C. The magnets N S are, of course, rotating all the time the engine is in operation. When the engine is on the compression stroke the cam shaft moves up, carrying the coil with it. On account of the magnetic field set up by the rotating magnets a high tension current would be set up in the coil. I am rather in doubt as to how much current could be produced, but I should think if the secondary were larger than most secondaries on gas engine coils enough current could be induced. The device could also be applied to automobile engines by means of a special device, which I have. The question of timing the discharge could be solved by moving either the coil or magnets. Do you think the device would work? Could a patent be obtained on such a device?"

A. This seems to us a good idea, altho it should be tried out first in practise. We are also afraid that more magnets than shown will have to be used in order to get a sufficiently strong spark. We also are afraid that unless the magnets are very powerful little current will be realized. When it is considered that even a small spark coil takes as much as five or six amperes it will be realized that in order to get sufficient electro-magnetic flux the permanent magnet would have to be exceedingly powerful.



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Submarines to Salvage Sunken Ships

(*Continued from page* 809)

means of a push button he gives the signal to the crew and comprest air is admitted to this chamber which forces or blows out all the water in it. Owing to the high air pressure, about 150 pounds to the square inch, a large opening can be used for blowing out the water, as with this heavy air pressure the water can be kept out of the chamber even with the valves left open to the sea. If this high air pressure was left passing into the chamber, once the water has been blown out of it, however, and then the inner compartment door opened, the diver would be quite likely forcibly ejected into the pontoon quarters. A better procedure is to close the sea-cocks as soon as all the water is blown out of the chamber. The comprest air would then be shut off, and allowed to lower itself to atmospheric pressure, or a pressure corresponding to that within the pontoon, if a higher one than normal happened to be in use at the time. The inner or right-hand door can then be opened, and the diver can pass into the regular quarters, remove his ponderous suit with its 100 pound, lead weighted shoes, undo his massive steel helmet, and sit down to a bowl of steaming clam chowder.

HOW SUNKEN SHIPS ARE RAISED.

Assuming that a large number of steel cables have been past around the wreck and that the time has come to attempt to raise it, the action is as follows:—When it is time to begin the raising operations, the pontoon sections are submerged to a reasonable depth and when everything is ready and the signal given by means of under-water sound telegraph or otherwise, the water is blown out of the submerged tanks of the pontoon and their buoyancy is re-established. Providing they have sufficient lifting power to raise the sunken ship, then they will slowly begin to rise, bringing up the wreck with them. In a great many locations advantage is taken of the rise and fall of the tide where such salvaging operations are undertaken and when the wreck has been raised a certain amount above the bed of the harbor or bay, the pontoons or vessels supporting the wreck by means of cables and so forth, steam toward the shore, so as to lodge the wreck on the sand in a more shallow location. The pontoons are submerged when they are favored by the low tide of the day, and they then draw up all cables tight. By submerging during this period for a certain depth they can then raise the wreck for another appreciable amount, and as the submarines can propel themselves along at a speed of several miles per hour, they can carry the wreck still further into more shallow water, etc., etc. Such a device as this would at least be a great help in salvaging operations, in conjunction with regular salvaging vessels and derricks, to say the least.

In some cases a sunken ship could be caused to almost (and in some cases) actually float itself by pumping comprest air into the hull of the wreck. Naturally, it is necessary to effectually close up any holes in the particular sections of the hull which are to be blown out by air and this is the work of the expert divers.

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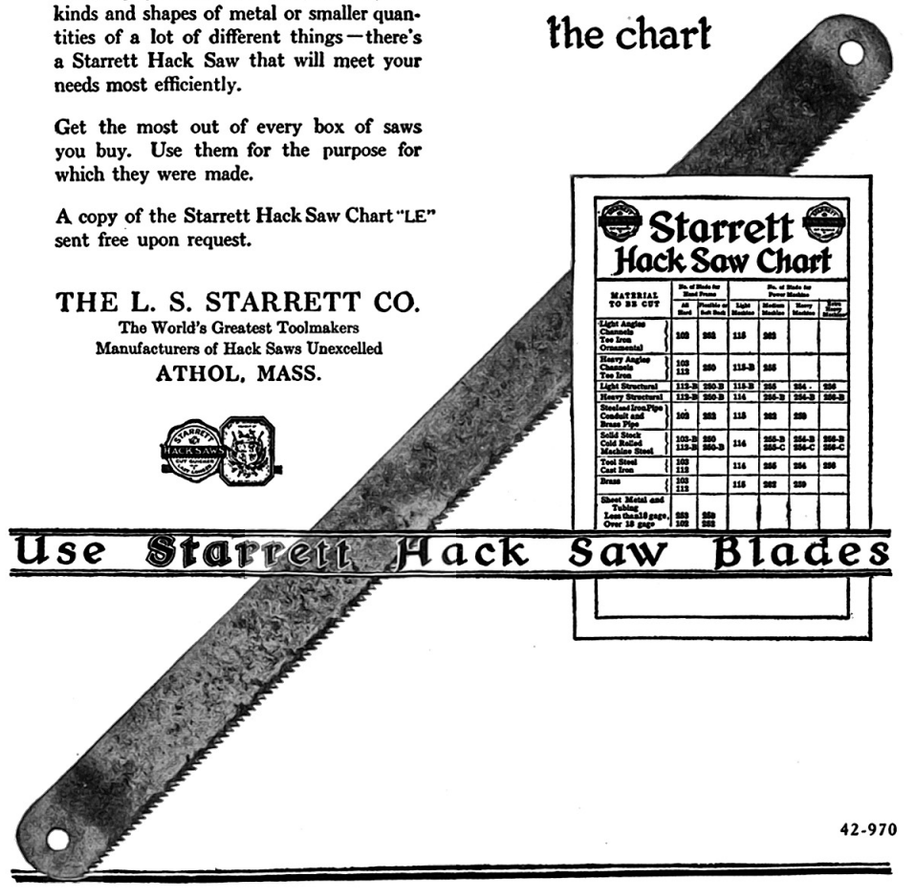

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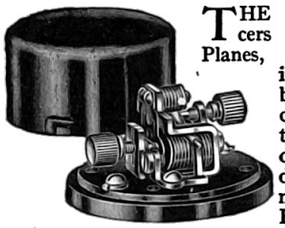

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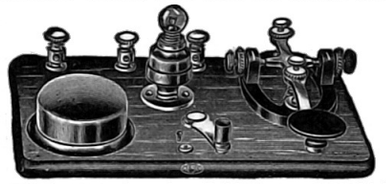

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Airplane Super-Charger for High Flying

By Charles M. Ripley

(*Continued from page 757*)

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Popular Astronomy

By Isabel M. Lewis, M.A.

Is the Moon Dead?

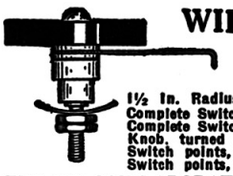
(*Continued from page 768*)

delicate clefts or rills, also in the appearance of dark spots from time to time and the darkening of the floor of craters as the altitude of the sun increases which cannot be shadow effects since at lunar mid-day when the darkening is most pronounced there are no lunar shadows.

The only plausible explanation of this periodic darkening during the lunar day is that it is due to the growth of some form of vegetation.

One of the most interesting and most convincing evidences of change in lunar markings is associated with the noted Ariadaeus and Hyginus cleft system which we note particularly since it is so well shown in the accompanying photograph taken at the Mt. Wilson Observatory. These two clefts in the lunar surface can be seen just above the northern edge of the photograph. The Ariadaeus cleft or rill originates well over to the west at the small crater Ariadaeus faintly visible in the lunar shadows and runs first north east then north to the edge of the photo. It will be observed that it cuts directly thru all craters and ridges in its path, a peculiar characteristic of all clefts. A careful examination of the photo will show that it is connected with the coarse Hyginus cleft to the south east (so named because it passes in its course directly thru the depression known as Hyginus, four miles in diameter) by a much fainter canal-like cleft. It is this connecting cleft that has shown evidence of change. Gruithuisen, a diligent lunar observer, detected this connecting cleft in the early part of the nineteenth century and noted that at times it appeared perfectly straight and at other times very irregular altho observed under the same conditions of phase and definition. Lohrmann and Mädler who later observed this region frequently never saw a trace of it. It was rediscov-

(*Continued on page 822*)



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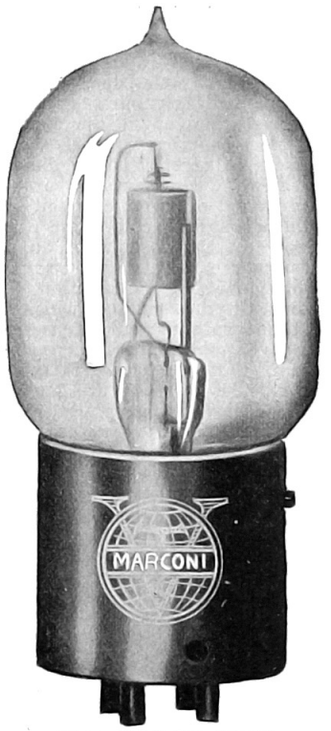

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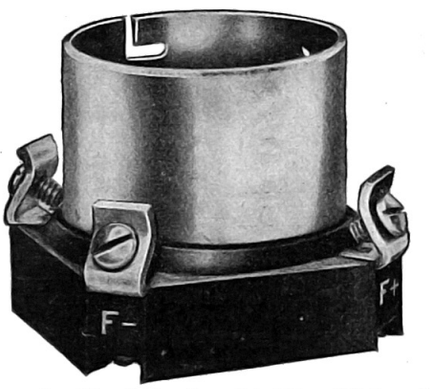

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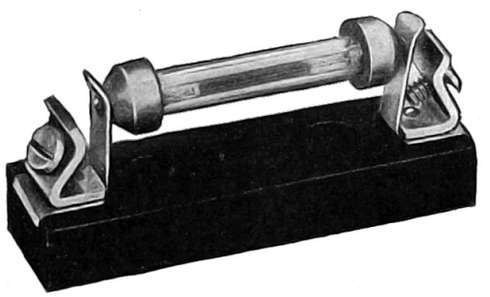

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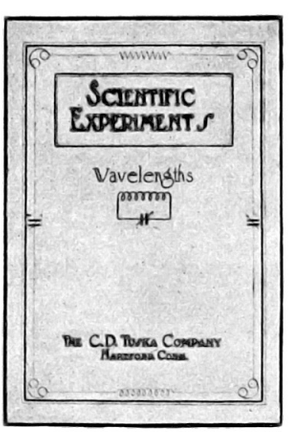

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Popular Astronomy

By Isabel M. Lewis, M. A.

IS THE MOON A DEAD WORLD?

(*Continued from page* 820)

ered by Schmidt in 1862. Klein, later, saw this cleft very clearly at times and again looked for it in vain under similar observing conditions. Elger found it an easy object with a 4-inch telescope. The latter observer, a noted selenographer who has also observed changes in the appearance of other clefts queries whether these are not instances of recent change difficult to "explain away." He says in part—"The more the study of minute detail is extended the stronger becomes the evidence that in spite of the absence of an appreciable atmosphere there may be something resembling low-lying exhalations from some parts of the surface which from time to time are sufficiently dense to obscure or even obliterate the region beneath them." Of the nature of the lunar clefts or rills he feels we are "supremely ignorant." They are generally regarded as huge cracks in the surface due to shrinking and contraction of the moon.

A most interesting rill system, partly traceable in this same photograph, is known as the Triesnecker system. It can be found to the southeast of the Hyginus cleft and west and north of the conspicuous ring-plain Triesnecker which can be seen about an inch above and a little east of the northern rim of the photograph.

Photographs fail to show the great complexity of this remarkable system. In studying all the intricate detail of the lunar markings the human eye is vastly superior to the photographic plate. Moreover, all these minute details are only revealed piece-meal, as it were. A cleft or rill that is very distinct under a low sun will usually disappear entirely under high illuminators.

The best time to study the details of the lunar surface is therefore *not* at or near the time of full moon, but when the object in question is illuminated by a low sun.

Changes of tint in the interior of the Hyginus cleft were noticed by Klein. At some points the reflected sunlight was decidedly yellowish, at others white as if the cliffs were snow covered.

Tho on the whole the lunar atmosphere is comparatively rare it is by no means impossible that certain dense and heavy gases may exist locally in considerable quantities, in fact that carbon dioxide and water vapor so essential to the growth of organisms may occur within the lunar cracks, crevices and numberless pits and depressions in even greater quantities than they are found in the earth's atmosphere of which they form a relatively small proportion, the amount of carbon dioxide in the earth's atmosphere at sea level being only three hundredths of one per cent.

If certain forms of life do exist on the moon it is certain they would be found on the low-lying maria and within the gigantic cracks of the lunar surface and all of its pits and depressions rather than upon the high snow-covered plains and ramparts of the southwest quadrant.

That a sort of vegetation may exist in the deeper seas is not so improbable. Elger noted a decided sepia color in the Mare Foecunditatis and within certain ring-plains and craters and many observers have recorded that some of the seas are darker than others and that all show local changes of tone. Networks of streaks intermingled with dark spots and minute brilliant points of light have been observed on the maria under good atmospheric conditions and many have noted in addition that certain of the "seas" appear yellowish or green.

(*Continued on page* 824)

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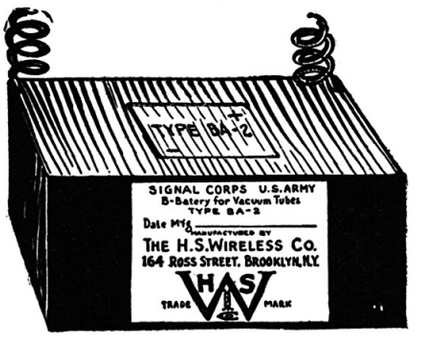

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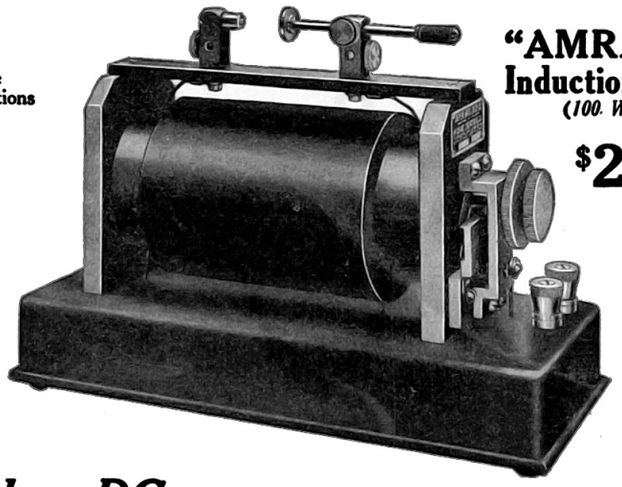

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Popular Astronomy

By Isabel M. Lewis, M. A.

IS THE MOON A DEAD WORLD?

(*Continued from page 822*)

The Mare Crisium containing about 70,000 square miles and considered to be the deepest of all the seas appears a light green under certain conditions. The central part of the Mare Humorum which is well shown in the accompanying photo taken by Ritchey with the 40-inch Yerkes refractor (see just south of the center of the eastern edge of the photo with the conspicuous ring-plain Gassendi on its border) has been described as a dusky green under good seeing conditions. This "sea" contains 50,000 square miles and is therefore about equal in area to New York State.

A class of lunar objects apparently very subject to change are the crater-cones that appear so frequently on the floors and walls of ring-plains and craters. Under high illumination they usually appear as white spots and the fact that they are associated with light streaks on the floors of craters seems to imply that they are volcanic vents. The lunar observer Klein firmly believed them to be volcanic and more recent observations substantiate this belief.

In October, 1916, Maggini observed reddish shadows spreading over part of the floors and walls of the crater Plato hiding temporarily one of the minute craters that dot the floor of this crater.

If active volcanic vents do exist on the moon we have here a source of supply of carbon dioxide and water vapor for the growth of lunar organisms in low-lying regions.

The blanketing effect of the carbon dioxide and water-vapor in our own atmosphere is well known and would tend there as well as here to mitigate the extremes of heat and cold at low levels.

A most interesting region of the lunar surface is to be found just north of the Hyginus cleft (see Mt. Wilson photo near center of the north edge). Here a mysterious black spot was discovered in 1877 by Klein which he described as a dark depression without a rim and one which he was sure he had never seen before tho he had scanned this region frequently during his twelve years of lunar observations. This spot was later observed by others under various solar altitudes appearing to many as "an ill-defined object with a somewhat nebulous border." In its vicinity lie two small craters and several low ridges. Whether this is really a new lunar marking is uncertain tho the evidence of change seems very strong.

Prof. W. H. Pickering, one of the chief selenographers of the present day, has recorded frequently many observations of lunar changes and his photographic atlas of the moon is well known. His observations are in accord with those of a number of other selenographers in indicating that activity upon the surface of the moon has not entirely ceased and that in fact our satellite may support certain forms of vegetation and even presumably of animal life in low lying regions where a comparatively dense gaseous medium whose chief components are carbonic acid gas and water vapor may well be found.

The high plateaus in the south west quadrant of the moon and the walls and peaks of the walled plains, ring-plains and craters that are massed there in the greatest profusion, most all observers are agreed, owe their dazzling brilliancy to a perpetual mantle of snow. The same dazzling whiteness also exists in the north and south polar regions of the moon.

On the whole, we may say that evidence that the moon is not an absolutely cold

and lifeless world is accumulating from many sources.

The most powerful telescope and the best seeing conditions are necessary to settle many of the questions of suspected changes as they are associated largely with the more minute markings.

Yet there are markings wherein changes are suspected that lie well within reach of very moderate instruments.

A four inch refractor or a six or eight inch reflector will show a number of lunar features not yet recorded on lunar maps.

There are many excellent and valuable lunar maps, in fact, the surface of the moon has been more carefully and accurately mapped than certain terrestrial regions, and there are in addition excellent photographic atlases obtainable so that the amateur who wishes to become acquainted with our nearest neighbor in space will find much helpful and valuable material at his disposal and if he pursues this line of study systematically and carefully he may find that his observations are of real scientific value.

The unsolved problems of the moon are many and perplexing and the true nature of its rays and rills, its craters and its maria still remains very uncertain in spite of many conflicting theories and so a wide field of investigation lies open to all.

QUESTIONS AND ANSWERS.

Question 1. Are the Pleiades the center of our stellar galaxy?

Answer 1. There is absolutely no foundation for this belief.

The Pleiades form what is known as a "loose moving star cluster" that cannot be, at the most, more than a few hundred light years from the solar system.

According to the recent investigations of Shapley the center of our galaxy lies, most likely, among the star clouds of Sagittarius at a distance of more than sixty thousand light years from the earth.

Question 2. Is the sidereal universe fathomless?

Answer 2. So far nothing is known to the contrary. We have as yet no reason to believe that the most powerful telescopes have penetrated to the limits of the universe and even if we were able to say definitely that we had reached the limit of our own particular sidereal system and that all the stars, star clusters and nebulae visible in our telescopes were units in one vast organization we would still be in doubt whether other systems might not lie beyond the confines of our own hidden from our view by some absorbing medium.

Question 3. What are "irresolvable" nebulae?

Answer 3. In small telescopes nebulae and star clusters cannot be distinguished from each other. As the magnifying power of telescopes increased it was found that many formations that had been formerly believed to be nebulae could be "resolved" by powerful telescopes into star clusters. Some astronomers then jumped to the conclusion that all nebulae could be resolved into star clusters in sufficiently powerful telescopes.

When spectroscopy was applied to astronomical research and the light of the irresolvable nebulae was analyzed, it was evident that some of these formations were truly gaseous and so never could be resolved into star clusters. The term irresolvable nebulae therefore has no special meaning at the present time when nebulae are classified as gaseous or continuous according to the type of spectrum they show. The continuous type to which the spiral nebulae belong might still be considered irresolvable to a certain extent since they have never been resolved into the stellar components of which they doubtless largely consist. Their true nature and relation to the stellar system is not yet definitely known.

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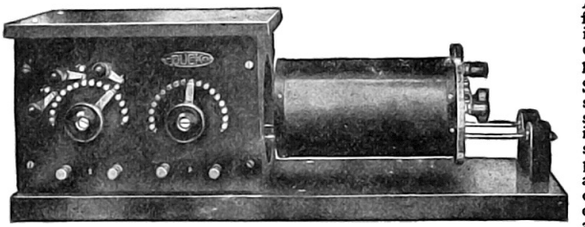

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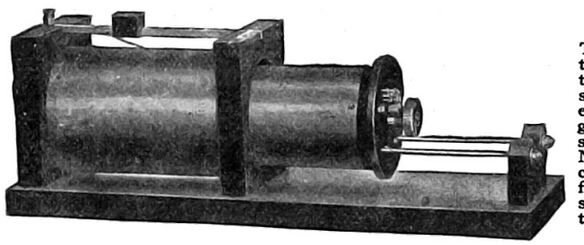

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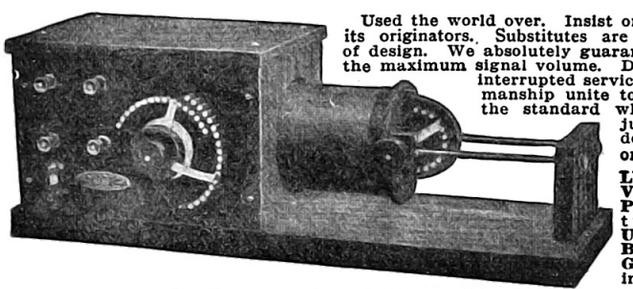

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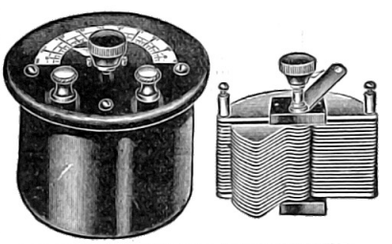

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(*Continued from page 760*)

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"The Lepere biplane, equipt with a Liberty motor, which Major Schroeder used in the altitude flight, has a horizontal speed at sea level of 136 miles an hour. At an altitude of more than 20,000 feet this speed, owing to the rarity of the atmosphere and the decreased engine power, falls to 105 miles an hour. Equipt with the supercharger device, the horizontal speed at 28,250 feet was maintained at more than 130 miles, or almost equal to the best possible at sea level. Major Schroeder found the compressor consumed only 5 or 10 per cent of the engine's horse power, while at 15,000 feet altitude it added 40 per cent to the power-plant's effectiveness. At 20,000 feet, 48 per cent was added and at 28,000 feet, 60 per cent was gained.

"The super-compressor is a device to utilize the waste exhaust gases of the engine itself to operate a small centrifugal air-blower which forces an air stream into the engine at a constant pressure about equal to the normal suction of the motor at sea-level pressure and thus maintains engine functioning approximately the same as under the best conditions at sea level.

"Major Schroeder and his passenger wore electrically-heated clothing and oxygen helmets. The record shows that the temperature at 28,250 feet was minus 29 degrees centigrade.

Carnarvon Radio Station

(*Continued from page 778*)

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There are three distinct types of transmitters installed (1) the synchronous alternating current sets; (2) Marconi

"timed-spark" continuous wave machine; (3) the arcs.

The synchronous A.C. sets are in duplicate and are of 300 k.w. capacity, each consisting of a 450 B.H.P. 440 volt 3-phase asynchronous motor driving a 300-k.w. single phase alternator, the working voltage of which is 1,750 volts. An extension of the alternator shaft drives the disc discharger thru an insulating coupling. The primary condenser bank has a capacity of 2.5 mfds and is charged by step-up transformers, the field of which can be adjusted so that the studs on the disc discharge the condenser at each peak of the alternation.

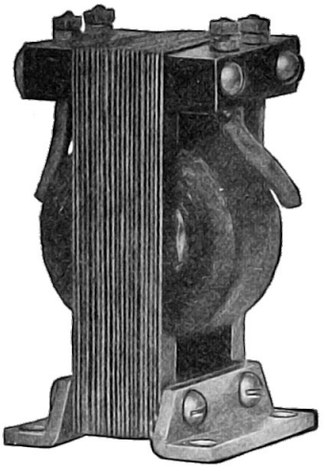
The timed spark continuous wave transmitter has two distinct primary circuits tuned to the same frequency and coupled to the aerial circuit. The condensers of these primary circuits are charged by 5,000 volt D.C. dynamos and discharged alternately by means of a special form of disc discharger so arranged that the trains of oscillations produced in the aerial by the successive discharges of the two condenser banks take place in phase with one another. This timing of the discharges is controlled by a trigger circuit which at a given instant ionises the gap between the studs and electrodes of the main circuits and enables them to discharge, special adjustments being provided for determining the moment of discharge. Signaling is effected by making and breaking the charging current of the trigger circuit, and as this current is only .5 amp. a very high rate of working is possible.

One of these transmitters of 300 k.w. capacity, capable of working at 200 words per minute, is already installed at the station and a duplicate set is in course of erection.

The 200 k.w. arcs are of the horizontal type and are fed thru choking coils and starting resistance from an 800 volt D.C. dynamo. The field of the arcs is separately excited from an auxiliary 110 volt D.C. dynamo which also supplies current for the pump motors, cathode motors, and spirit relays. Methylated spirit is automatically fed into the arc chamber which, with its lid, anode and cathode, is water cooled, a relay being provided in the water circuit to cut off the current to the arc should the water supply fail.

A special receiving station at Towyn is intended for all the receiving and operating work, and is provided with apparatus for duplexing the service. At Carnarvon, however, for special war purposes, receiving apparatus has been installed with a range of from 3,000 meters to 16,000 meters. The aerial is inductively coupled to an intermediate circuit which in its turn is coupled to an amplifying and self-heterodyning valve circuit. By means of magnifiers in the telephone circuit arrangements are made for either automatic reception at high speed, or to enable the operator to receive without wearing telephones. The signaling key for operating by hand is placed in the receiving room, where there is also a Wheatstone automatic transmitter capable of working at a speed of 200 words per minute. For this high speed working high tension signaling switches worked by a Creed comprest air engine is used for slow transmission. Galvanometer type signaling switches are provided, but both types can be operated from relays, either by the hand key or by the Wheatstone transmitter.

Altho the Carnarvon station is primarily intended to work to America it has successfully communicated with Sydney, Australia, thus proving that it is powerful enough to cope with any distance up to the limit of possible long-distance transmission on the earth, it being understood that modern receiving apparatus is employed at the Antipodes.—*Photos courtesy Marconi's Wireless Telegraph Company, Ltd.*



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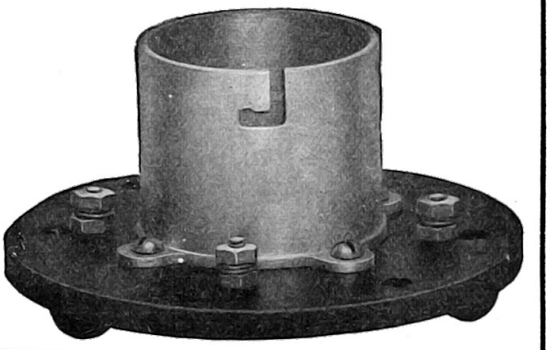

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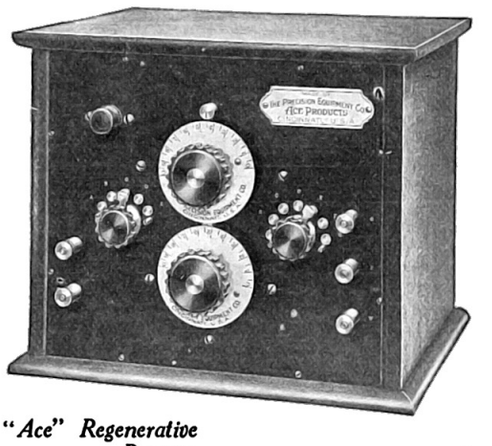

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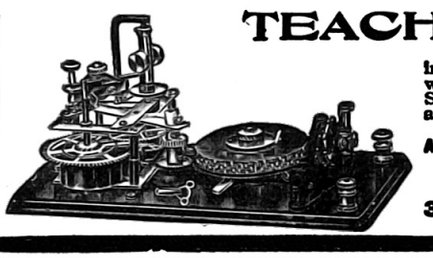

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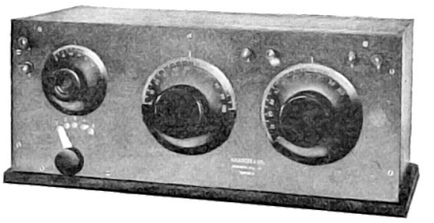

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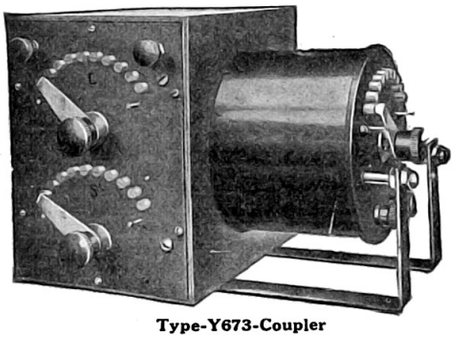

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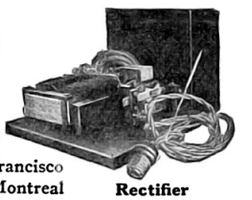

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DORON BROS. ELECTRICAL CO. Hamilton, Ohio

Modern American Radio Apparatus

(*Continued from page 779*)

In this new system the machine that generates these electrical oscillations is known as the *Alexanderson alternator* which has the advantage of giving a *pure wave* by virtue of which messages sent by different stations do not interfere with one another. There is just as much improvement in this new system over the older method as there is between the modern balanced telephone line and the old single-wire telephone on which the cross talk of neighbors could be overheard.

A new device known as the magnetic amplifier is employed as a modulator of the electric oscillations. This new device has no moving parts and this fact, coupled with its magnetic properties, renders it so quick as to make possible the transmission of telegraph messages at the rate of several hundred words a minute and also enables the amplification of the modulations of the telephone currents into oscillations sufficiently powerful to carry the human voice across the Atlantic. In all the different radio systems the radiator is called the antenna and up to the present time the antenna has been very inefficient, the useful energy radiated amounting to from 5 to 10 per cent. In the Alexanderson system a multiple tuned antenna is an important feature and increases the radiation efficiency from 20 to 50 per cent.

The company has developed such high frequency alternators for radio work in capacities of 1, 2, 50, and 200 kilowatts. It was one of these 200 kilowatt machines that did such good work at the New Brunswick station during the war, so it is interesting to note that a unit of this size *radiates approximately 250 h.p. of energy into space when it is sending a radio message.* The peculiar advantages of this type of generator is that it gives out an undamped wave and puts such a large amount of energy into the antenna; factors which led to the rapid extension of the use of radio communication during the war, and also led to the building of so many new transmitting stations as well as the use of this means of communication for spreading propaganda.

Over and above the radio work referred to the company's radio developments were many and varied. A description of all the work done seems impractical, so to give a general idea of some of this work that had been completed or was nearing completion at the time the armistice was signed, it will be well to classify it as follows:

(a) Large size vacuum tube apparatus
(b) Medium size vacuum tube apparatus
(c) Small size vacuum tube apparatus
(d) Receiving apparatus

All these new developments were carried out under war-time conditions, at high pressure, and under numerous difficulties caused by the rapid change of requirements.

The term "vacuum tube apparatus" may need a word of explanation: it refers to that type of transmitter and receiver which makes use of the vacuum tube as an oscillator, amplifier and receiver. Such tubes are usually made of glass and generally contain three electrodes. The tube is exhausted and the Research Laboratory at Schenectady has done much notable work in producing a tube of higher voltage and greater power output than hitherto had been found possible. The physical properties of the tube, which is termed a "pliotron," are dependent upon the motions of the electrons set free from the heated filament in a nearly perfect vacuum. We shall refer at greater length further on to this subject.

Most radio apparatus, previous to the development of these tubes, employed what are commonly termed "damped waves," which means that for a portion of the time there was no activity. With the vacuum tube undamped waves are used in which there is no period of inactivity; this results in a higher efficiency.

In pre-war days the advantages of the undamped oscillations were well recognized and apparatus of this description had largely displaced the older damped apparatus on the score of greater efficiency, the ability to use the lower voltage, small size, and also because of certain advantages in reception; but this new type of apparatus had not been used to any large extent in the smaller radio outfits.

The war-time requirements of both the army and the navy were of a very special nature and called for a great number of small sized, short range radio sets of light weight and small cubic capacity; these features being particularly valuable in aircraft outfits. To meet these requirements, the vacuum tube apparatus was developed and was applied in several unique ways to the aircraft service, particularly in its application to telephonic communications. All sets developed by the company were arranged for telephonic communication on the continuous wave and telegraphic communication on both continuous and "chopt" wave.

Aircraft are of various sizes and therefore several different types of apparatus were designed to meet the differing requirements, but finally the design settled down to three types, each particularly suitable for a certain class of airplane. Thus the large size vacuum apparatus was primarily intended for bombing planes, flying boats, and balloons; the medium size for such craft as seaplanes and biplanes; and the small size for the smallest class of flying machines, which usually carry only one aviator.

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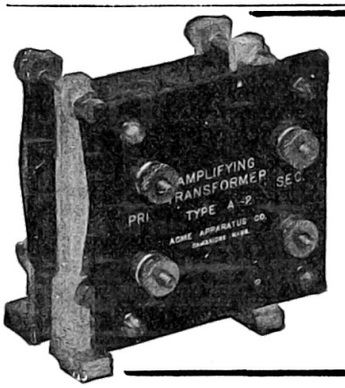

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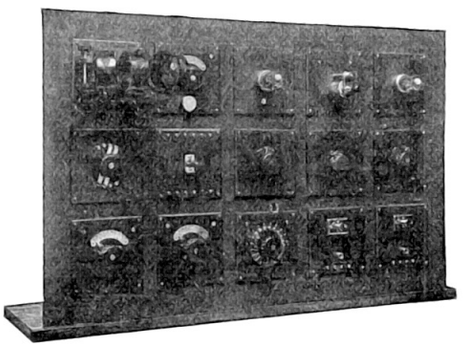

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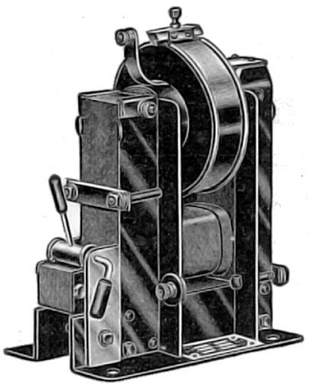

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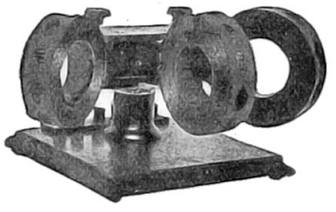

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The large size vacuum tube apparatus uses the largest type of pliotron that the company has developed and is adapted for use at fixt land bases for controlling the fleet movement of a large number of planes by telephone. Such sets radiate about 1½ horse power of energy and are capable of giving telephonic communication with a flying boat at a distance of at least 200 miles. Similar units were designed for installation on army tractors for field operation. These also had a range of 200 miles, and at the time the armistice was signed a number of orders were under way for radio telephone sets for this service. An aircraft unit using this large vacuum tube was designed which only weighed 70 pounds, exclusive of the storage battery.

An aircraft radio telephone unit using the medium size vacuum tube was developed, and is now being produced in large quantities. It has a telephonic range from plane to ground of a hundred and fifty miles and weighs only about 40 pounds, exclusive of the battery.

A great amount of work was done on a radio telephone set using the smallest size of vacuum tube and the weight had been brought down until the complete transmitter, exclusive of the battery, weighed only 25 pounds. This set had a range of 60 miles from the fixt station and communication was obtained over a distance of ten miles between two similar planes.

The vacuum tube, commonly called the *pliotron,* and mentioned so often in this story, deserves many chapters to cover the fascinating story of its development; particularly the truly wonderful scientific laws which govern its action and the almost unbelievable amount of work that was accomplished by this concern in supplying the needs of the army and navy with these tubes. The amount of progress that the world owes to these tubes is a source of just pride to the workers of the Research Laboratory at Schenectady where so much of the development work was done that led to their present highly developed state. But owing to there being so much that is of interest, we shall have to confine our remarks to one or two brief paragraphs.

The practical long distance telephone really owes its development to the pliotron, and the advances it has enabled to be made in wireless telegraphy are great and far reaching.

These tubes depend for their action on the emission of electrons from a heated cathode which crossing a gap arrive at the anode, thus conveying an electric current across the gap. The ability to produce high power tubes depends on many factors, but the most important is to obtain a very high degree of vacuum.

As soon as America entered the war and the requirements of the government were learned, two lamp factories were started on the wholesale production of the vacuum tube and provided equipment to turn out 20,000 per week. This concern supplied the army and navy with many thousands of pliotrons for the airplane and seaplane service and many hundreds of the complete wireless outfits already described.

Men talking across the broad expanse of the Atlantic ocean without a wire is romantic enough of itself, but what of an "Ace" with his radio set controlling the fleet action of a mighty host of flying battleships engaged in deadly battle miles up in the air.

It seems fanciful, but it is real that today we send men miles up into the air to obtain meteorological information of distant points and have the information telephoned back to us on earth. These are indeed messages from the ethereal blue.—*Photos courtesy General Electric Co.*

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Ships Guided by Electrified Cable

(*Continued from page 746*)

to the experts of the navy who have tested it, and recommended its use, is fool-proof and as reliable as the telephone. It will work in all conditions of water and weather and no amount of electricity in the air or power of the wireless can affect it in any way.

Earl C. Hanson, who is only 28, has been granted basic patents on the system. During the war he donated to the government all his inventions.

Gen. Pershing directed Col. John H. Parker to secure the use of the device for communications in the first battle lines and trenches, and only the signing of the armistice prevented its universal use in the American Expeditionary Forces, it is said.

The cost of installation will be much less than the installation of lighthouses, buoys, lightships, and other fog signals, with the added advantage that the system works without interruption from storms or fogs or other atmospheric conditions, claims the inventor.

It is difficult to estimate the economical saving that will be brought about by the universal installation of the Hanson system, which is applicable to any type of harbor. It may be considered as a refining feature of the *radio compass* which was developed under the direction of Capt. S. C. Hooper, of the radio division, bureau of steam engineering, Navy Department. R. H. Marriott, expert radio aid of the Navy Department, has conducted tests using the audio system for guiding ships in tests on the Pacific Coast with gratifying results.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, of Electrical Experimenter, publisht monthly at New York, N. Y., for October 1, 1919.

State of New York, County of New York—ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of the Electrical Experimenter, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations:

1. That the names and addresses of the publisher, editor, managing editor and business managers are: Publisher, The Experimenter Publishing Co., 233 Fulton St., New York City; Editor, Hugo Gernsback, 233 Fulton St., New York City; Managing Editor, H. W. Secor, 233 Fulton St., New York City; Business Manager, R. W. DeMott, 233 Fulton St., New York City.

2. That the owners are: Experimenter Publishing Co., 233 Fulton St., New York City; Hugo Gernsback, 233 Fulton St., New York City; Sidney Gernsback, 233 Fulton St., New York City; H. W. Secor, 233 Fulton St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is —(Required only of daily publications.)

(SEAL.) H. GERNSBACK.

Sworn to and subscribed before me this 9th day of Oct., 1919.

BEATRICE K. OWEN.

(My commission expires Mar. 30th, 1921.)

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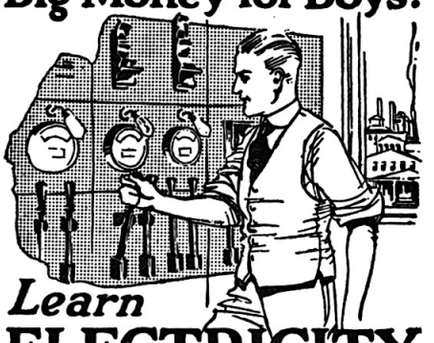

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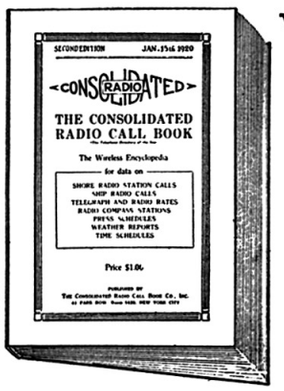

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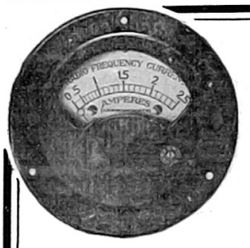

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FOR RADIO CPERATORS.

An S. O. S. call for radio operators has been sent out by the United States Shipping Board.

All Shipping Board vessels carry one or two wireless operators. During the war many radio operators were trained. Any who desire employment, Shipping Board officials recently stated, have only to secure a radio operator's license, which is issued by the Department of Commerce after passing the required examination.

Under the new wage scale of the Shipping Board the first operator, who is in charge on vessels where two operators are employed, is paid $125 per month and the second operator $100 per month, *in addition to all expenses.* The radio operator is considered an officer and is provided superior accommodations.

All radio men who are qualified radio operators and who desire to be considered for the service should communicate with the Radio Department Division of Operators, United States Shipping Board, Washington, D. C.

Did the Romans Have Wireless?

(*Continued from page* 747)

Solaro, 1,980 feet. Signals were probably not sent from here, but from the eastern headland. The Pharos was about 1,000 feet above sea level. A line drawn from the Pharos to Monte Circeo, on the Campanian coast, just grazes the Island of Ischia; but the line of sight would be well above the island, as the summit of Circeo is 1,775 feet.

"A suggested line of stations with no range more than 44 miles long is submitted to those of a speculative turn of mind. (See illustration herewith.) Rome to Monte Cavo, in the Alban Mountains, 18 miles; thence to Monte Circeo, 39 miles; thence to Monte Massico, 44 miles; thence to Capri, 44 miles. A Pompeian fresco of quite recent discovery shows Monte Cavo as being very conspicuous when viewed from the Palatine Hill. The clear summit is boldly visible. Perhaps the Palatine Hill was the 'sending' station in Rome."

Sound and Flash Ranging in the A. E. F.

By Prof. Augustus Trowbridge

(*Continued from page* 759)

A survey by means of sound is based on the assumption that sound travels from the gun in a spherical wave at a known rate (about 1100 feet per second) in still air at a given temperature; an increase in temperature increases this rate by a known amount; if the air is not still but blowing with a known speed in a known direction the apparent speed of sound under these conditions may be calculated. If the *time of arrival* of the sound of a gun is measured at three surveyed points on the ground, the position of the gun can be calculated as will be evident from the accompanying diagram in which G is the gun, P_1, P_2 and P_3 any three surveyed points within the friendly lines at which instruments are placed capable of indicating electrically on a recorder at a central station the times of arrival (t_1, t_2 and t_3) at them, of the sound of the enemy gun.

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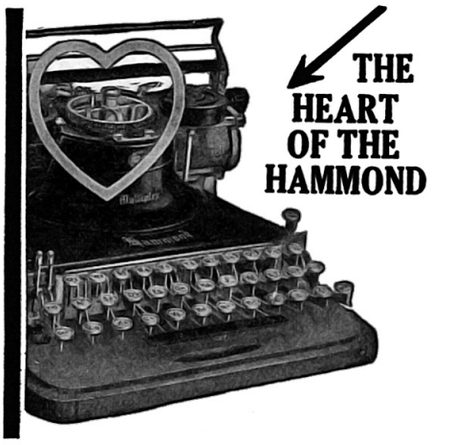
If the sound arrives at P_1 at time t_1 and at P_2 at time t_2, then the interval t_2-t_1 must be the time necessary for the sound to travel the distance r_2 where $r_2 = V\ (t_2 - t_1)$ if V is the velocity of sound in still air at some standard temperature. Also $r_3 = V\ (t_3 - t_2)$. One can of course reverse the above reasoning if the intervals $(t_2 - t_1)$ and $(t_3 - t_1)$ be known, by drawing circles of radii r_2 and r_3 around P_2 and P_3 respectively and drawing tangent to these circles and through the point P_1 a third circle $P_1\ Q_1$, at the center of which the gun must lie if there be no wind or temperature corrections; if these have to be made a slight and calculable shifting of the point G results.

The method just described would be an entirely correct graphical one to employ in calculating a gun's position from the observed time intervals, but it was found too slow and slightly too inexact for practical use, and therefore *plotting boards* were prepared by a method involving the principle of that just described but which permitted the use of strings in place of lines drawn on the board; also in practice six instruments P_1, P_2, P_3, P_4, P_5, P_6, were used instead of the three theoretically necessary in order to insure greater accuracy and to allow of work being carried on while one or two of the instruments might be temporarily out of order because of the electrical connections to "central" being cut by shell fire.

One of the accompanying illustrations gives an idea of the character of the photographic records from which sound ranging locations were made; the six horizontal lines between the two rows of perforations are the records of the six instruments P_1 — P_6; the heavy short vertical lines, the rather faint long lines and the very faint long lines are respectively half-seconds, tenth seconds and hundredth seconds recorded by the means of a very accurate tuning fork. When the sound of a gun reaches the instrument P_1 (for example) the top element of the record shows a "nick" in the line, and as the sound reaches the other instruments "nicks" appear in the corresponding lines and the time intervals $t_2 - t_1$, etc., may be quickly read off by counting the number of tenth and hundredth seconds between the "nicks."

An idea may be formed of the accuracy of sound ranging locations from the accompanying diagram in which the actual gun positions are plotted from a survey made after the position had been captured by our troops; this survey was made by army topographic officers who were not themselves interested in proving or disproving the accuracy of sound ranging. The surveyed gun positions are marked with a small square. The locations made by the sound rangers had been rated when reported to the artillery according to the actual probable error as follows: A location reported "P" (none in the case of this battery) was probably accurate to within fifty yards; a "Q" location (marked with a small circle) accurate to within a hundred yards; an "R" location, 150 yards and a "RR" location, 200 yards, marked respectively as dots and crosses. Had the estimate of probable accuracy been correct, all the crosses should have been *outside* the outer oval figure; all the dots should have been between the outermost and the next oval; the circles should have been in the next region, etc. It will be seen that the estimate of accuracy was much too conservative. The triangle marks the average of all the sound ranging locations on this battery and is less than 20 yards in error. The scale of the drawing is such that the large square represents a square kilometer. The sound ranging instruments were about eight kilometers (five miles) distant from the battery.

Sound ranging was also used to direct the fire of the friendly artillery on invisible



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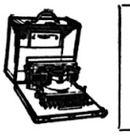

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targets; the method was similar to that employed for the location of the enemy guns but with the difference that it was the report of the burst of the friendly artillery's shells that was recorded instead of the report of the enemy gun. When the target was an enemy gun which had recently fired and been located by the sound rangers, the accuracy obtained in ranging the friendly artillery was extremely great, since no uncertain wind and temperature corrections had to be applied, as the effect of wind and temperature on the records of enemy gun and the shells of the friendly artillery was the same and therefor could be disregarded.

An idea may be gained of the *amount* of artillery information supplied by the flash and sound ranging sections from the following extract taken from the report of the artillery information officer of one of the American corps. This officer had at the time as sources of information three American sound ranging sections, two American and three French flash ranging sections (later three American and two French flash ranging sections) aviation and observation balloons. During a period of three weeks of rapid advance, 425 separate locations of enemy batteries were made; of these the two American flash sections reported 63 per cent; the three French flash sections reported 16 per cent, and the three American sound sections reported 21 per cent. In a period of two weeks, when the advance had been temporarily checked by the enemy, the total number of locations was 392, and the percentages were: From the three American flash sections 38 per cent; from the two French flash sections 8 per cent and from the three American sound sections 54 per cent. In another and very active sector the figures were: During a period of three days' preparation for an advance, sound locations 22, flash 22; balloons, 0, aviation, 0. During a period of sixteen days of rapid advance; sound 4, flash 46, balloons 30, aviation 15. During a period of four days of stabilization; sound 6, flash 34, balloons 13, aviation 15. These figures are fairly characteristic. During preparations for an advance, both the sound and flash sections are very useful sources of information. During rapid advance the sound rangers do not get into action as often as the flash, because of the greater technical difficulties. During this period the major part of the information comes from the aerial observation.

American flash and sound ranging sections were operating on the front from March, 1918, until the armistice and always in sufficient numbers to cover the sectors held by American troops, except for a portion of the front of the Argonne offensive when the line was moving extremely rapidly. The work of the officers and men of the 74th Engineers engaged in this service was of a very high order, and their untiring watchfulness was often the indirect means of saving the lives of countless of their fellow soldiers by affording the information needed to silence the fire of the enemy guns.

SOUND AND FLASH RANGING IN THE A. E. F.

[Editorial Notes.]

No microphones were used by the A. E. F. in sound ranging. Also no earth-borne vibrations used.

The Bureau of Standards made exhaustive tests for several years, not to mention hundreds of tests conducted by the U. S. Army Corps of Engineers, which have demonstrated that it is not practicable to endeavor to use sound wave transmission thru the earth. This is so for one basic reason, viz.: That the velocity of sound varies for each different kind of earth, such as damp earth, wet earth, dry earth, rock, sand, chalk, etc.

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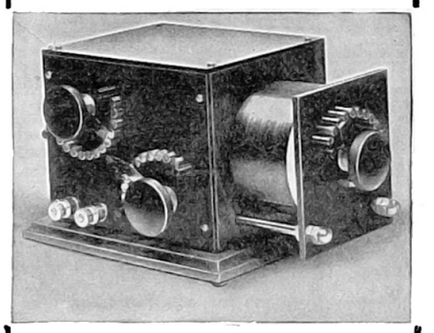

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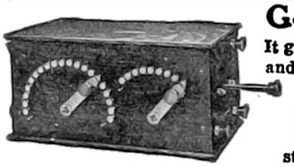

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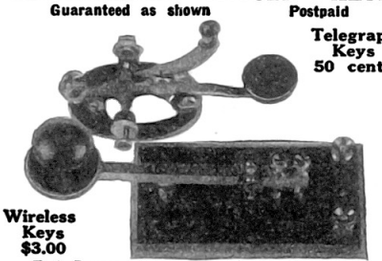

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What was used, then, in the A. E. F., when the U. S. Army Corps of Engineers who took charge of all this work during the war on the whole American front (every yard of which was fully protected by this apparatus for accurately locating the German guns from the time that the first American troops went into action) until the close of the war? No sound vibrations thru the earth, to begin with, and no microphones.

When Colonel Trowbridge arrived in France, he was given charge of this work for the A. E. F., and was appointed to the staff of Gen. Pershing at Headquarters. Very shortly, and in conjunction with some laboratory work which has been carried on in the Palmer Physical Laboratory at Princeton University, an entirely new method of "Sound Ranging" was developed. In the first place, sound vibrations as transmitted thru the *air* were used in contra-distinction to the sound waves originally used, which were transmitted thru the *earth*. A new sound translating device was constructed for the purpose, which yielded wonderful results. This instrument comprises nothing else than a series of fine, electrically heated wires, forming a *grid*. This grid of fine wires which were heated red hot by a strong current transmitted from the central station of a given sound-ranging sector, was suddenly cooled *by the blast of the onrushing sound wave* transmitted thru the air whenever a German gun was fired, even though it was four to five miles away.

To begin with, the velocity of sound wave propagation was constant to a very close degree, and this insured the success of the new system from the start. When the sound wave reached the location of the thermal sound detector, several of which were installed on well charted locations, there was caused a variation in the air at this point.

To intensify this effect, the next step was to place the grid device, which was a small affair, on to some acoustic resonating chamber which would be affected in a more or less pronounced manner so as to reinforce pneumatically the local effect of the air wave variation when it arrived.

At first, English "whiskey jugs" were used, and the grid thermal detector was clamped to the top of the jug. When the sound wave arrived in the vicinity of these jug detectors, a puff of air would rush into the jug, and out again, thus causing a variation in the heating of the wire and this partial cooling and change in the heating would change the resistance of the line, and cause the recording apparatus at the central station to register a "wiggle" on a rapidly moving photographic paper strip such as here shown, which corresponds to the enemy gun or guns. Later, several important and unique features in connection with this very interesting sound detector, were observed and put into effect. Due to the fact that the soldiers used to smash the jugs repeatedly in an effort to see whether there was any whiskey inside, researches were quickly made, and finally gasoline and kerosene cans came into use. The grid was now clamped on the opening of the can, and presently it was discovered that in order to render the device more quickly damped in its operation, and to give but one deflection on the record, that this quality could be effected by simply punching some small holes around the can, so that the opening where the air enters the can when the sound wave arrives, did not tend to keep vibrating; but due to the air escaping thru the small holes, it would damp out quickly.

The only really special apparatus required, was the recording instrument which comprised an Einthoven string galvanometer provided with six strings or wires

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tightly suspended in a very powerful magnetic field. These galvanometers were built by a large American telephone concern under rush orders from France. Time division marks on the charts on which the records were made, were produced by a clever revolving toothed disc driven synchronously in front of the beam of light from a 24 C.P., 6 volt, battery lamp, and projected on to the photographic paper strip. All of this apparatus was straightway provided. This photographic recorder carries a large roll of sensitized paper strip, and when set in motion a large drum carries the paper around in front of the shutter, exposes it, cuts the exposed section off, puts it thru a developing and fixing solution and turns it out on the receiving tray—all of these operations taking place in about *three-quarters of a minute!* So much for this recording apparatus at present.

The next point of interest leads us to the front line trenches and their vicinity, where sound ranging posts were stationed. The observers were sometimes stationed in dugouts *in advance* of the front line trenches. Each observer had a switch or key, and a telephone of course. Whenever he saw or heard the enemy's gun fired, he immediately prest his key, which operated a series of relays connected by means of wires running back to the recording station of that particular sound ranging section. One of the relays closed the grid current circuit thru the hot wire grid on the whiskey jugs or gasoline cans, which were sprinkled over the field in the vicinity of the front line trenches. Another relay started the recording apparatus in motion. The incandescent lamp burned all the time in front of the galvanometer telescope. Thus, it is shown that by the time the sound wave arrived from the gun fired, which may have been anywhere from two to eight miles away, the apparatus was in full operation and ready to record the "bursts." The method of arranging the various sound wave detectors along the arc of a circle is described in the article by Prof. Trowbridge.

The American type of air wave "sound detectors," were arranged of course to deflect the rain and other elements. The proper current was maintained thru each hot wire grid in the following manner. When the grid was installed, its resistance was noted as marked on a tag accompanying it. All circuits operated in the A. E. F. were full metallic (two wires), and no ground circuits were used under penalty of court martial and a possible sentence of death. This was done to prevent the enemy from intercepting any signal (telephonic or telegraphic) due to leakage from grounded circuits. The wires were No. 12 heavy rubber covered conductors.

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The "Finer Workings" of Static Electricity

By Frederick Von Lichtenow

(*Continued from page* 774)

maximum value. The charge thus gained is then applied to the pith ball hanging from its insulating support, which was made use of in the preceding experiment (pith ball to be first neutralized, of course), with the result that the light body will be strongly repelled by the El-cover. This shows, that the former is fully charged. (It will retain the charge for quite a while!)

A sheet of glass, about 1/16 thick, of a somewhat smaller size than the hard rubber plate, is then placed between the latter and the metal cover (Fig. 2) and the charging process gone thru as before. The spark discharges will in this case, naturally, be of a weaker nature, but the polarity of the sparks will in both cases be the same, that is +, which is manifest thru the repulsive action upon the charged pith ball.

Simple as the experiment itself is, its underlying principle is of a more complicated character. There seems to exist only one tangible explanation for the whole action, which, broadly speaking, touches upon the condenser principle in *a modified form.* It is well to observe, that the glass, not being a conductor, will not take a charge directly applied, but will hold such of opposite sign (+) to that of the charging body (—) on its face next to the same *as long as it is in contact with the latter,* while this induced charge, on the other hand, superinduces such of, again, opposite polarity (—) upon the upper surface of the glass sheet.

What finally becomes of both these induced Electro-static charges remains an open question, since the glass plate can not be tested for its respective former polarities after being removed from the charging body; and so this particular problem winds up in a case of *"Spurlos Versenkt"!* The fact remains, that, in the above connection, a negative charge is found upon the glass's upper side and is retained there (it is never repelled there as it would on a conductor!) gradually diminishing in value with that upon the hard rubber plate.

For the sake of the uninitiated or some "Doubting Thomas" and to emphasize the fallacy of another possible (on their part) version of the principle action, I may state here, that in the above case the original charge *does not penetrate,* unchanged in sign and simply lessened in power *thru the sheet of glass,* for this fact alone would be sufficient to eliminate the use of glass for a condenser—as well as insulating—purposes and, for that matter, would have done so long ago.

The diagram in Fig. 2A. shows the distribution of the electrostatic charges upon the various parts of the apparatus, while the latter are in electrical contact with one another.

EXPERIMENT NO. 3.

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The addition of the *sheet of glass* is *essential, because it "slows down," as well*

(*Continued on page* 839)

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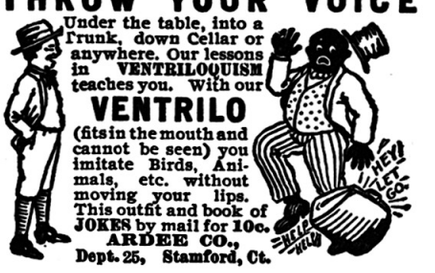

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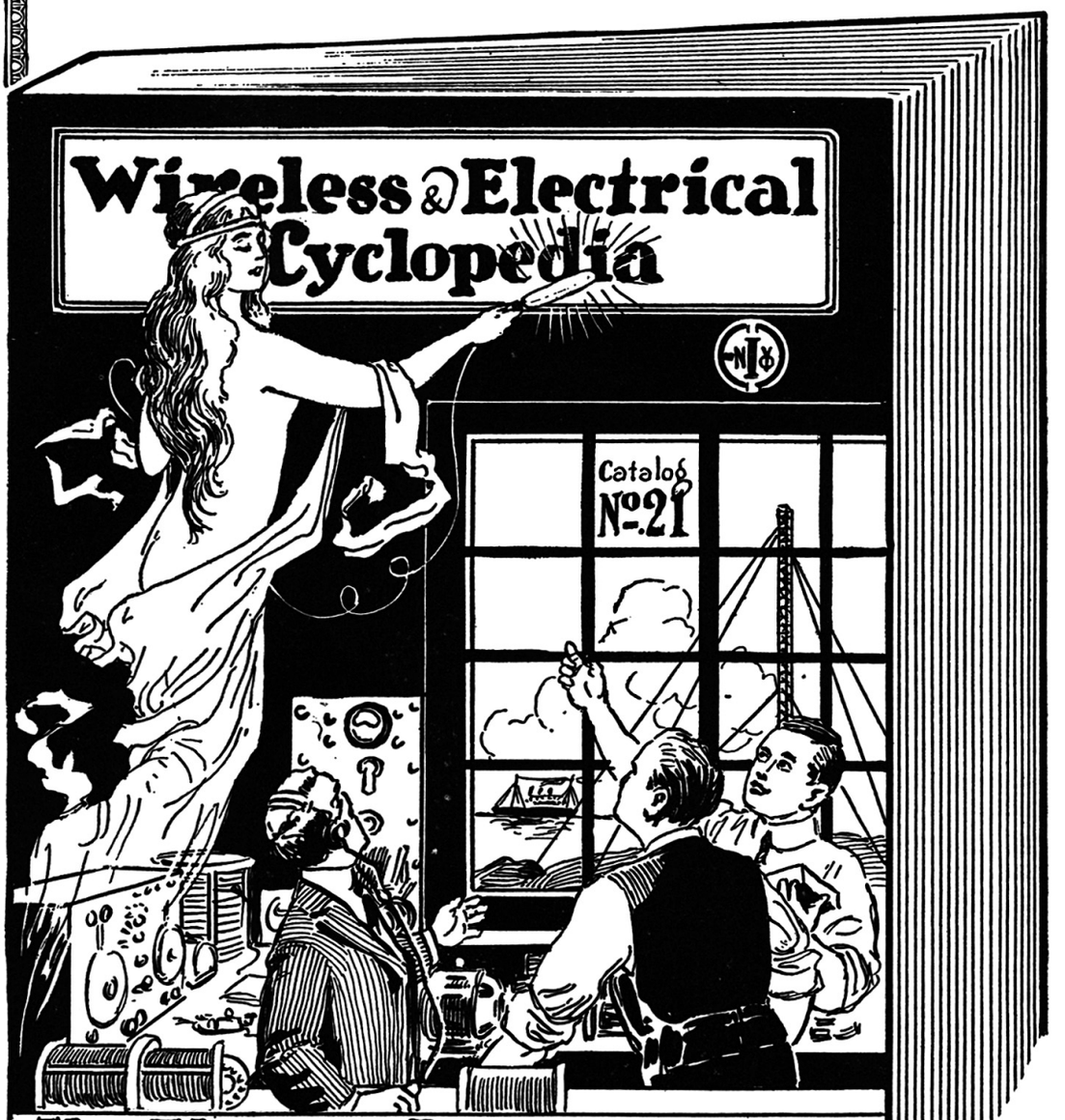

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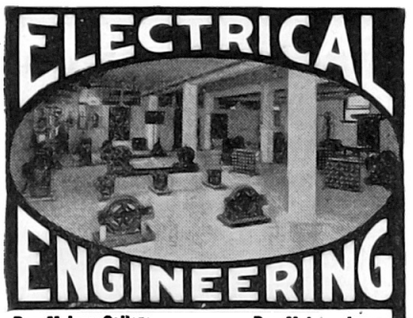

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The "Finer Workings" of Static Electricity

By Frederick Von Lichtenor

(*Continued from page* 837)

as exposes (as far as this possibly can be done) *"those workings" of, the action, which ordinarily take place, but do not manifest themselves,* all of which will be more fully understood later on.

Fig. 3 indicates the respective positions of the instruments to one another, which are to be placed in line, with the insulating sheet *very close* to the neutral body. This is important as the success of the experiment depends upon this factor more than on anything else. Care must, consequently, be taken in finding the *proper* distance between the sheet of glass and the pith ball, which, generally speaking, is about equal to the thickness of the glass itself, but which has really to be found by experimentation, since this is subject to the volume of the induced charge, the size of the pith ball, the temperature of the surrounding air, etc., etc.

With the apparatus arranged as above suggested, the charged El-cover is moved slowly in the direction of the pith ball, whereupon the latter, altho separated from the cover by several inches, will be "pushed" onto the insulating sheet and cling there. At this very juncture, that is, without bringing the charged cover any closer, all action on the part of the operator should cease for a while. Thus keeping the cover in its last position, the pith ball will soon loose its hold upon the surface of the glass and swing over toward the charged cover. As the gap between both is shortened or widened by the operator, so will the light object, naturally, be more strongly attracted or allowed to swing back onto the sheet of glass, as the case may be, but *it will not cling to the latter any more.* (Under no circumstances and at no stage of this experiment should the pith ball be permitted to make contact with the Electrophorus cover, for this would destroy the principle of the inductive action with one stroke!) On getting the light object once more "under control" by shortening this gap, the opportunity offers itself for the removal of the insulating body, which is then done. After this the charged cover is also removed. An investigation will show the existence of a small charge upon the pith ball, which the latter acquired during the process and which is evidenced thru its attractive properties when in contact with any neutral object.

Although quite a few things happen in this little experiment, the explanation for the whole action is very clear and as follows: The (+) charged El-cover, on being approached to the pith ball, induces a negative charge upon the part of the latter facing it, while a charge of opposite sign is repelled to the other side of the ball. This repelled positive element does *under ordinary conditions,* that is, without the addition of the insulating sheet, *not manifest its existence.* In the above case, however, it will find a complement of negative electrons on the sheet of glass, to which, in accordance with the *law of attraction of opposite polarities,* it will attach itself. This negative element, again, is the result of the disturbance of the "electrical balance" upon the insulating body, while under the influence of the repelled positive charge (if not even under that of the original [Electrophorus cover] charge); and to enable both these weak charges to reach one another, the sheet of glass must find its place close to the pith ball, which was clearly pointed out in the foregoing. Since a second object is absolutely imperative in order to bring out this, otherwise, "lost

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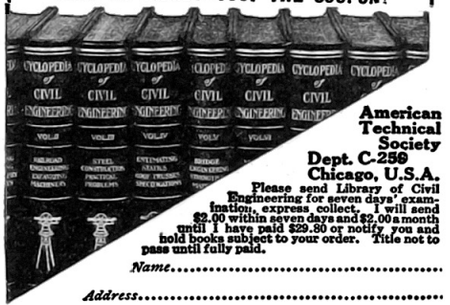

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action", which will now be fully understood, and since a conductor has, for obvious reasons, to be avoided, an insulating body, as the *"last* best thing", is consequently chosen.

The latter (sheet of glass in the above case) possesses qualities which tend to retard the process to a certain extent and which is clearly demonstrated, when the pith ball clings to the insulating sheet for a while. In doing so, the small amount of repelled positive charge becomes neutralized and *neutralization of a charged object in contact with an insulating body takes place very gradually,* which accounts for the "slowed down" action. The negative element induced upon the pith ball remains there, however, as at this stage of the experiment the electrophorus cover (+) is still held in its rigid position. Upon separating itself from the sheet of glass again, the ball will be evenly charged *negatively* and consequently strongly attracted by the (+) charged cover.

The minute charge found finally upon the pith ball, that is, after both sheet and cover have been removed, is acquired by the latter upon contact with the insulating body and is really not to be included in the inductive action of an electrostatic charge upon a neutral body, (altho similar conditions may prevail [for all we know] in space, where the "bigger workings" occur, and give reason for just such an action). It should, in the above case, rather be considered a "necessary evil", which finds its way into the experiment, with the operator not finding a way out of preventing it from getting in there. For with the elimination of the insulating body a successful "work-out" of the whole action is impossible, which is now quite clear; nor is it possible, while employing this very essential insulating factor, to prevent the pith ball from making contact with it, and yet observe the minute manifestation of the repelled element *by way of attraction only;* the close proximity of the two, necessitated by the very weak nature of the charge, stands against this.

If in this experiment the pith ball, after its separation from the sheet of glass, should again cling to the same, this shows that the repelled positive charge (on the ball) has *not* been completely *neutralized,* which, as pointed out in Experiment No. 1, finds its main reason in too low a potential of the Charge-source (El-cover) and, consequently, of the "counter-charges" induced upon the other instruments. The *proper* charge, neither excessively higher nor too low, for such purposes as the above, has to be found by actual experimentation.

The diagram in Fig. 3-A illustrates the experiment in its various, principal stages.

EXPERIMENT NO. 4.

(Imprisoning Charge Upon Neutral Body by Induction)

Many things, indeed, may be studied in this experiment, the main object of which is to prove the fact, that a neutral body may be put in a charged condition entirely thru the power of induction of an electrostatic element.

Depicted in Fig. No. 4 are the instruments, required for the experimental "work-out", which eliminates a further description of the same, beyond stating, that the two neutral bodies (pith balls) must hang side by side (touching one another) in the same plane and that they are suspended from *separate* silk-threads, so as to enable the operator to remove one of them, when the necessity arrives; the reason for this will be clear after a while.

The charged hard rubber plate is approached to the light objects in the manner that the plate faces only one of the balls, whereupon, at a certain distance, both of the latter (still keeping contact with one another) will be slightly attracted by the charged hard rubber sheet. Here the sheet should become "rigid," that is, not be moved any closer. After a short while the

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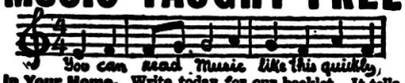

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two bodies will separate; one will swing over toward the charge-source and attach itself to it, while the other (the one further away from the plate) evidences a *repulsive* action. The sheet of hard rubber (ebonite) and ball No. 1, are then removed together, by simply lifting the latter with the plate from its support (which is easily accomplished as long as the ball has not lost its "hold" upon the electrified sheet!) Great care must, however, be taken in doing so, not to bring these two objects any closer to the remaining ball; not to speak of permitting any contact between them. After this has been carefully done, the solitary ball will, upon test with a neutral body, be found to be in a charged condition, although in the above arrangement it never came in *direct* "touch" with the charge-source.

The explanation for the above will be found in the following: on approaching the two neutral bodies with the electrified hard rubber plate, its negative charge induces a (+) charge upon *the side* of the first ball, *which it faces,* repelling at the same time such of its own sign (—) to the other side of that ball. This repelled negative element, again, attracts the positive electrons found in the second pith ball to the part of the latter, which is in contact with ball No. 1, while a charge of opposite polarity (—) will be repelled toward its part farthest away from the charged plate. With the latter approaching gradually closer, both balls will be moderately attracted to the same (to be exact: the nearest ball is attracted, while the other one is simply pulled along!); and that they still keep together during this motion, is due to *neutralization* of their "inner charges", *which invariably manifests a "clinging action" while taking place.*

After the act of neutralization has been completed, both separate, whereupon the first ball, now left (+) charged, will be strongly attracted to the (—) electrified sheet and consequently attach itself to it, while ball No. 2, will be distinctly repelled on account of its now evenly negative polarity. At this stage of the experiment both, charge-source and ball No. 1, are removed, as was outlined before; and I may mention here, that the (in the above connection) slow process of neutralization of the (+) element induced upon that pith ball makes this "holding together"—removal possible. (This ball will finally, that is, after being neutralized, be negatively charged [higher potential of plate!] and repelled, which, however, has *no bearing in this experiment*).

The negative charge, which in the end is found imprisoned upon the remaining pith ball, is the direct result of neutralization of the induced "inner" charges between the *bodies,* with *their* immediately following *separation* and simultaneously *that* of *their "spell-bound" charges,* all happening under the influence of the inductive energy emanating from the charge-source; and, consequently, this negative charge is of a truly induced character.

Fig. 4-A, gives a clear demonstration of the principal actions which take place in this experiment.

Concerning the apparata themselves I may say, that they should be kept clean and in a dry condition, in which they always are, when in their *proper* place in a comfortably heated room. In case of excessive dampness of the atmosphere they may be placed upon a radiator for a short while, but must never be heated nor employed while in such a condition, because some of the apparatus (hard rubber sheet, for instance!) will doubtless suffer under such treatment and because thermo-(heat-) waves upon the apparatus will introduce erroneous manifestations into the experiments, which do not belong in there, thus counteracting the desired actions, if not nullifying them entirely.

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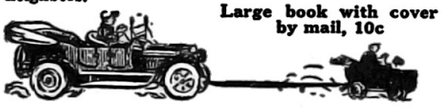

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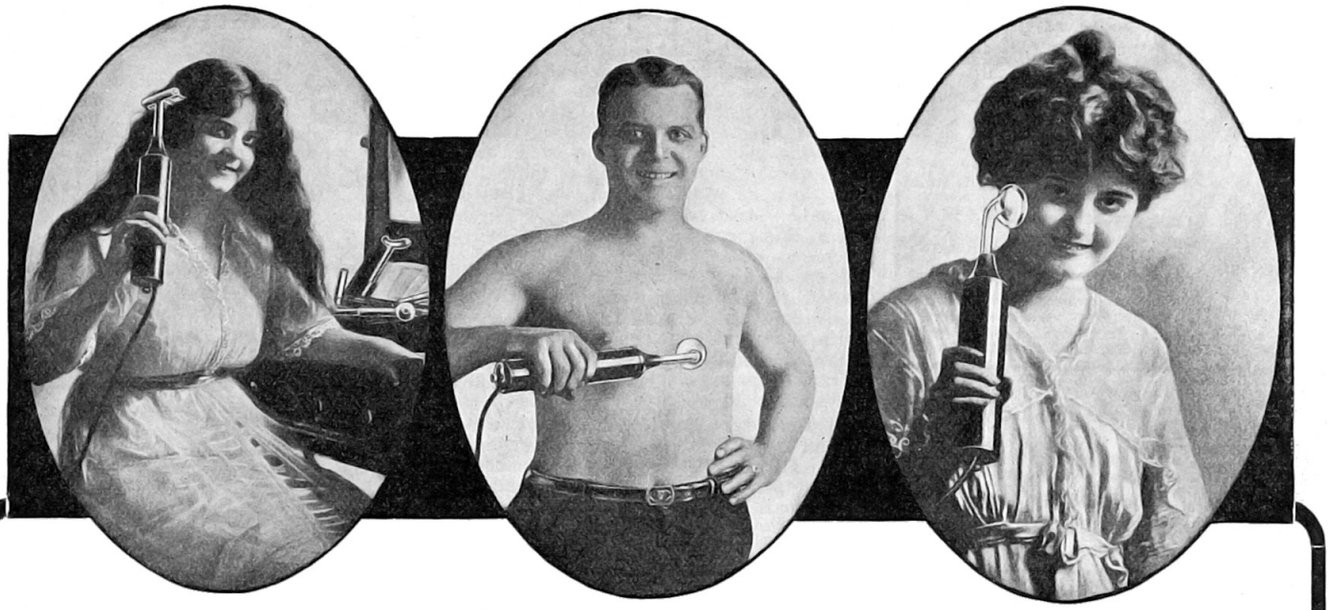

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Don't confuse the VIOLETTA with Vibrating Machines. It is not a Vibrator. It does not contract the muscles or shock the nerves. Its magic rays pass completely through the body, producing "cellular massage," known to be far more beneficial than muscular massage. It leaves no soreness after use—only delightful, agreeable relief.

VIOLETTA
Violet Ray Machine

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Boils
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Tonsilitis
Whooping Cough

What Physicians and Users Say

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K. L. Allen, D. C., 205 Boone National Building, Boone, Iowa, says: "I have had very good results with the application of High Frequency Current in cases of Paralysis, Rheumatism and Neuritis, and think it a great help in drugless healing."

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(Continued on page 844)

(*Continued from page 843*)

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(*Continued on page 846*)

(*Continued from page 845*)

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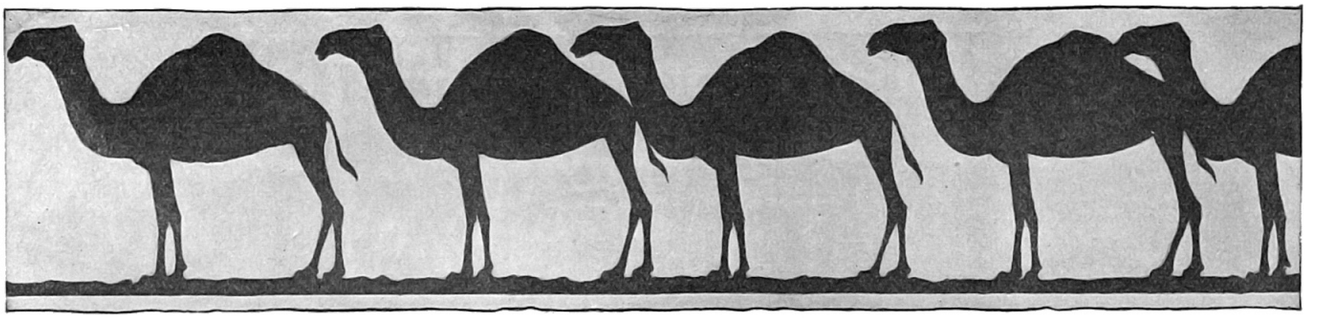

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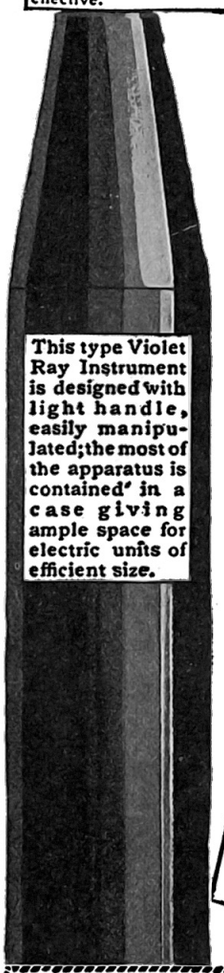

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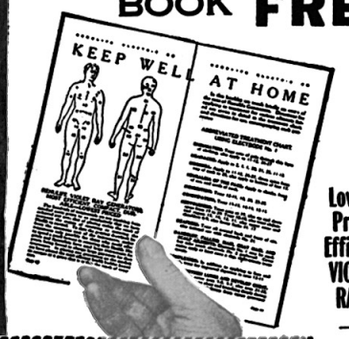

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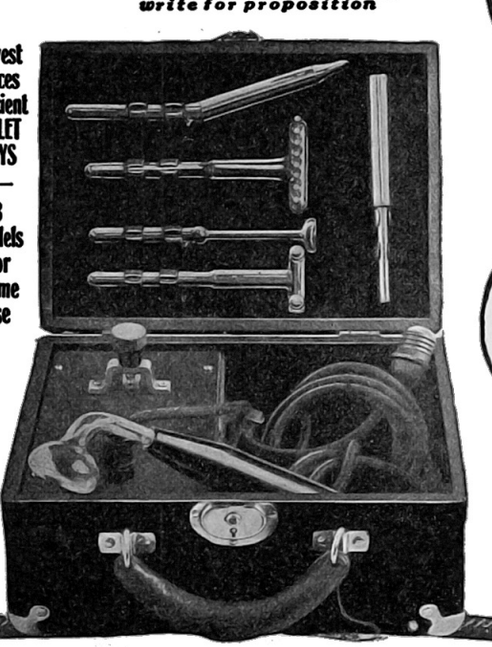

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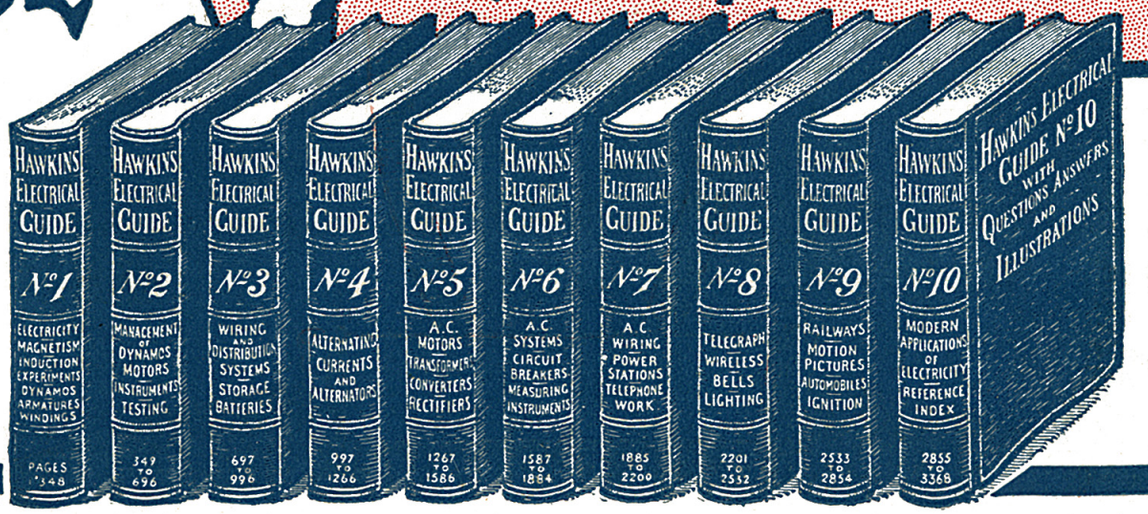

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